



The Pan book of MATHEMATICAL TABLES

compiled by
A. MONTAGUE-BEART

TP84

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**An important new reference book —
for the student and
for everyone in the expanding
technical professions**

MATHEMATICAL TABLES

THE PAN BOOK OF
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A. MONTAGUE-BEART



A PAN ORIGINAL

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LOGARITHMS

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
10	.0000	.0043	.0086	.0128	.0170	.0212	.0253	.0294	.0334	.0374	4	8	12	17	21	25	29	33	37
11	.0414	.0453	.0492	.0531	.0569	.0607	.0645	.0682	.0719	.0755	4	8	11	15	19	23	26	30	34
12	.0792	.0828	.0864	.0899	.0934	.0969	.1004	.1038	.1072	.1106	3	7	10	14	17	21	24	28	31
13	.1139	.1173	.1206	.1239	.1271	.1303	.1335	.1367	.1399	.1430	3	6	10	13	16	19	23	26	29
14	.1461	.1492	.1523	.1553	.1584	.1614	.1644	.1673	.1703	.1732	3	6	9	12	15	18	21	24	27
15	.1761	.1790	.1818	.1847	.1875	.1903	.1931	.1959	.1987	.2014	3	6	8	11	14	17	20	22	25
16	.2041	.2068	.2095	.2122	.2148	.2175	.2201	.2227	.2253	.2279	3	5	8	11	13	16	18	21	24
17	.2304	.2330	.2355	.2380	.2405	.2430	.2455	.2480	.2504	.2529	2	5	7	10	12	15	17	20	22
18	.2553	.2577	.2601	.2625	.2648	.2672	.2695	.2718	.2742	.2765	2	5	7	9	12	14	16	19	21
19	.2788	.2810	.2833	.2856	.2878	.2900	.2923	.2945	.2967	.2989	2	4	7	9	11	13	16	18	20
20	.3010	.3032	.3054	.3075	.3096	.3118	.3139	.3160	.3181	.3201	2	4	6	8	11	13	15	17	19
21	.3222	.3243	.3263	.3284	.3304	.3324	.3345	.3365	.3385	.3404	2	4	6	8	10	12	14	16	18
22	.3424	.3444	.3464	.3483	.3502	.3522	.3541	.3560	.3579	.3598	2	4	6	8	10	12	14	15	17
23	.3617	.3636	.3655	.3674	.3692	.3711	.3729	.3747	.3766	.3784	2	4	5	7	9	11	13	15	17
24	.3802	.3820	.3838	.3856	.3874	.3892	.3909	.3927	.3945	.3962	2	4	5	7	9	11	12	14	16
25	.3979	.3997	.4014	.4031	.4048	.4065	.4082	.4099	.4116	.4133	2	3	5	7	9	10	12	14	15
26	.4150	.4166	.4183	.4200	.4216	.4232	.4249	.4265	.4281	.4298	2	3	5	7	8	10	11	13	15
27	.4314	.4330	.4346	.4362	.4378	.4393	.4409	.4425	.4440	.4456	2	3	5	6	8	9	11	13	14
28	.4472	.4487	.4502	.4518	.4533	.4548	.4564	.4579	.4594	.4609	2	3	4	6	7	9	10	12	13
29	.4624	.4639	.4654	.4669	.4683	.4698	.4713	.4728	.4742	.4757	1	3	4	6	7	9	10	11	13
30	.4771	.4786	.4800	.4814	.4829	.4843	.4857	.4871	.4886	.4900	1	3	4	6	7	9	10	11	12
31	.4914	.4928	.4942	.4955	.4969	.4983	.4997	.5011	.5024	.5038	1	3	4	6	7	8	10	11	12

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
32	.5051	.5065	.5079	.5092	.5105	.5119	.5132	.5145	.5159	.5172	1	3	4	5	7	8	9	11	12
33	.5185	.5198	.5211	.5224	.5237	.5250	.5263	.5276	.5289	.5302	1	3	4	5	6	8	9	10	12
34	.5315	.5328	.5340	.5353	.5366	.5378	.5391	.5403	.5416	.5428	1	3	4	5	6	8	9	10	11
35	.5441	.5453	.5465	.5478	.5490	.5502	.5514	.5527	.5539	.5551	1	2	4	5	6	7	9	10	11
36	.5563	.5575	.5587	.5599	.5611	.5623	.5635	.5647	.5658	.5670	1	2	4	5	6	7	8	10	11
37	.5682	.5694	.5705	.5717	.5729	.5740	.5752	.5763	.5775	.5786	1	2	3	5	6	7	8	9	10
38	.5798	.5809	.5821	.5832	.5843	.5855	.5866	.5877	.5888	.5899	1	2	3	4	5	7	8	9	10
39	.5911	.5922	.5933	.5944	.5955	.5966	.5977	.5988	.5999	.6010	1	2	3	4	5	7	8	9	10
40	.6021	.6031	.6042	.6053	.6064	.6075	.6085	.6096	.6107	.6117	1	2	3	4	5	6	8	9	10
41	.6128	.6138	.6149	.6160	.6170	.6180	.6191	.6201	.6212	.6222	1	2	3	4	5	6	7	8	9
42	.6232	.6243	.6253	.6263	.6274	.6284	.6294	.6304	.6314	.6325	1	2	3	4	5	6	7	8	9
43	.6335	.6345	.6355	.6365	.6375	.6385	.6395	.6405	.6415	.6425	1	2	3	4	5	6	7	8	9
44	.6444	.6454	.6464	.6474	.6484	.6493	.6503	.6513	.6522	.6532	1	2	3	4	5	6	7	8	9
45	.6532	.6542	.6551	.6561	.6571	.6580	.6590	.6599	.6609	.6618	1	2	3	4	5	6	7	8	9
46	.6628	.6637	.6646	.6656	.6665	.6675	.6684	.6693	.6702	.6712	1	2	3	4	5	6	7	8	9
47	.6721	.6730	.6739	.6749	.6758	.6767	.6776	.6785	.6794	.6803	1	2	3	4	5	6	7	8	9
48	.6812	.6812	.6830	.6839	.6848	.6857	.6866	.6875	.6884	.6893	1	2	3	4	5	6	7	8	9
49	.6902	.6911	.6920	.6928	.6937	.6946	.6955	.6964	.6972	.6981	1	2	3	4	5	6	7	8	9
50	.6990	.6998	.7007	.7016	.7024	.7033	.7042	.7050	.7059	.7067	1	2	3	3	4	5	6	7	8
51	.7076	.7084	.7093	.7101	.7118	.7126	.7135	.7143	.7152	.7161	1	2	3	3	4	5	6	7	8
52	.7168	.7177	.7185	.7193	.7202	.7210	.7218	.7226	.7235	.7244	1	2	2	3	4	5	6	7	7
53	.7243	.7251	.7259	.7267	.7275	.7284	.7292	.7300	.7308	.7316	1	2	2	3	4	5	6	6	7
54	.7324	.7332	.7340	.7348	.7356	.7364	.7372	.7380	.7388	.7396	1	2	2	3	4	5	6	6	7
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LOGARITHMS

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55	.7404	7412	7419	7427	7435	7443	7451	7459	7466	7474	1	2	2	3	4	5	5	6	7
56	.7482	7490	7497	7505	7513	7520	7528	7536	7543	7551	1	2	2	3	4	5	5	6	7
57	.7559	7566	7574	7582	7589	7597	7604	7612	7619	7627	1	1	2	3	4	4	5	6	7
58	.7634	7642	7649	7657	7664	7672	7679	7686	7694	7701	1	1	2	3	4	4	5	6	7
59	.7709	7716	7723	7731	7738	7745	7752	7760	7767	7774	1	1	2	3	4	4	5	6	7
60	.7782	7789	7796	7803	7810	7818	7825	7832	7839	7846	1	1	2	3	4	4	5	6	6
61	.7853	7860	7868	7875	7882	7889	7896	7903	7910	7917	1	1	2	3	3	4	5	5	6
62	.7924	7931	7938	7945	7952	7959	7966	7973	7980	7987	1	1	2	3	3	4	5	5	6
63	.7993	8000	8007	8014	8021	8028	8035	8041	8048	8055	1	1	2	3	3	4	5	5	6
64	.8062	8069	8075	8082	8089	8096	8102	8109	8116	8122	1	1	2	3	3	4	5	5	6
65	.8129	8136	8142	8149	8156	8162	8169	8176	8182	8189	1	1	2	3	3	4	5	5	6
66	.8195	8202	8209	8215	8222	8228	8235	8241	8248	8254	1	1	2	3	3	4	5	5	6
67	.8261	8267	8274	8280	8287	8293	8299	8306	8312	8319	1	1	2	3	3	4	4	5	6
68	.8325	8331	8338	8344	8351	8357	8363	8370	8376	8382	1	1	2	3	3	4	4	5	6
69	.8388	8395	8401	8407	8414	8420	8426	8432	8439	8445	1	1	2	3	3	4	4	5	5
70	.8451	8457	8463	8470	8476	8482	8488	8494	8500	8506	1	1	2	2	3	4	4	5	6
71	.8513	8519	8525	8531	8537	8543	8549	8555	8561	8567	1	1	2	2	3	4	4	5	5
72	.8573	8579	8585	8591	8597	8603	8609	8615	8621	8627	1	1	2	2	3	4	4	5	5
73	.8633	8639	8645	8651	8657	8663	8669	8675	8681	8686	1	1	2	2	3	4	4	5	5
74	.8692	8698	8704	8710	8716	8722	8727	8733	8739	8745	1	1	2	2	3	4	4	5	5
75	.8751	8756	8762	8768	8774	8779	8785	8791	8797	8802	1	1	2	2	3	3	4	5	5
76	.8808	8814	8820	8825	8831	8837	8842	8848	8854	8859	1	1	2	2	3	3	4	5	5

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
77	.8865	8871	8876	8882	8887	8893	8899	8904	8910	8915	1	1	2	2	3	3	4	4	5
78	.8921	8927	8932	8938	8943	8949	8954	8960	8965	8971	1	1	2	2	3	3	4	4	5
79	.8976	8982	8987	8993	8998	9004	9009	9015	9020	9025	1	1	2	2	3	3	4	4	5
80	.9031	9036	9042	9047	9053	9058	9063	9069	9074	9079	1	1	2	2	3	3	4	4	5
81	.9085	9090	9096	9101	9106	9112	9117	9122	9128	9133	1	1	2	2	3	3	4	4	5
82	.9138	9143	9149	9154	9159	9165	9170	9175	9180	9186	1	1	2	2	3	3	4	4	5
83	.9191	9196	9201	9206	9212	9217	9222	9227	9232	9238	1	1	2	2	3	3	4	4	5
84	.9243	9248	9253	9258	9263	9269	9274	9279	9284	9289	1	1	2	2	3	3	4	4	5
85	.9294	9299	9304	9309	9315	9320	9325	9330	9335	9340	1	1	1	2	3	3	4	4	5
86	.9345	9350	9355	9360	9365	9370	9375	9380	9385	9390	1	1	1	2	3	3	4	4	5
87	.9395	9400	9405	9410	9415	9420	9425	9430	9435	9440	0	1	1	2	2	3	3	4	4
88	.9445	9450	9455	9460	9465	9470	9474	9479	9484	9489	0	1	1	2	2	3	3	4	4
89	.9494	9499	9504	9509	9513	9518	9523	9528	9533	9538	0	1	1	2	2	3	3	4	4
90	.9542	9547	9552	9557	9562	9566	9571	9576	9581	9586	0	1	1	2	2	3	3	4	4
91	.9590	9595	9600	9605	9609	9614	9619	9624	9628	9633	0	1	1	2	2	3	3	4	4
92	.9638	9643	9648	9652	9657	9661	9666	9671	9675	9680	0	1	1	2	2	3	3	4	4
93	.9685	9689	9694	9699	9703	9708	9713	9717	9722	9727	0	1	1	2	2	3	3	4	4
94	.9731	9736	9741	9745	9750	9754	9759	9763	9768	9773	0	1	1	2	2	3	3	4	4
95	.9777	9782	9786	9791	9795	9800	9805	9810	9814	9818	0	1	1	2	2	3	3	4	4
96	.9823	9827	9832	9836	9841	9845	9850	9854	9859	9863	0	1	1	2	2	3	3	4	4
97	.9868	9872	9877	9881	9886	9890	9894	9899	9903	9908	0	1	1	2	2	3	3	4	4
98	.9912	9917	9921	9926	9930	9934	9939	9943	9948	9952	0	1	1	2	2	3	3	4	4
99	.9956	9961	9965	9969	9974	9978	9983	9987	9991	9996	0	1	1	2	2	3	3	4	4

ANTI-LOGARITHMS

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
.00	1000	1002	1005	1007	1009	1012	1014	1016	1019	1021	0	0	1	1	1	1	1	2	2
.01	1023	1026	1028	1030	1033	1035	1038	1040	1042	1045	0	0	1	1	1	1	1	2	2
.02	1047	1050	1052	1054	1057	1059	1062	1064	1067	1069	0	0	1	1	1	1	1	2	2
.03	1072	1074	1076	1079	1081	1084	1086	1089	1091	1094	0	0	1	1	1	1	1	2	2
.04	1096	1099	1102	1104	1107	1109	1112	1114	1117	1119	0	1	1	1	1	1	1	2	2
.05	1122	1125	1127	1130	1132	1135	1138	1140	1143	1146	0	1	1	1	1	1	1	2	2
.06	1148	1151	1153	1156	1159	1161	1164	1167	1169	1172	0	1	1	1	1	1	1	2	2
.07	1175	1178	1180	1183	1186	1189	1191	1194	1197	1199	0	1	1	1	1	1	1	2	2
.08	1202	1205	1208	1211	1213	1216	1219	1222	1225	1227	0	1	1	1	1	1	1	2	2
.09	1230	1233	1236	1239	1242	1245	1247	1250	1253	1256	0	1	1	1	1	1	1	2	2
.10	1259	1262	1265	1268	1271	1274	1276	1279	1282	1285	0	1	1	1	1	1	1	2	2
.11	1288	1291	1294	1297	1300	1303	1306	1309	1312	1315	0	1	1	1	1	1	1	2	2
.12	1318	1321	1324	1327	1330	1334	1337	1340	1343	1346	0	1	1	1	1	1	1	2	2
.13	1349	1352	1355	1358	1361	1364	1368	1371	1374	1377	0	1	1	1	1	1	1	2	2
.14	1380	1384	1387	1390	1393	1396	1400	1403	1406	1409	0	1	1	1	1	1	1	2	2
.15	1413	1416	1419	1422	1426	1429	1432	1435	1439	1442	0	1	1	1	1	1	1	2	2
.16	1445	1449	1452	1455	1459	1462	1466	1469	1472	1476	0	1	1	1	1	1	1	2	2
.17	1479	1483	1486	1489	1493	1496	1500	1503	1507	1510	0	1	1	1	1	1	1	2	2
.18	1514	1517	1521	1524	1528	1531	1535	1538	1542	1545	0	1	1	1	1	1	1	2	2
.19	1549	1552	1556	1560	1563	1567	1570	1574	1578	1581	0	1	1	1	1	1	1	2	2
.20	1585	1589	1592	1596	1600	1603	1607	1611	1614	1618	0	1	1	1	1	1	1	2	2
.21	1622	1626	1629	1633	1637	1641	1644	1648	1652	1656	0	1	1	1	1	1	1	2	2
.22	1660	1663	1667	1671	1675	1679	1683	1687	1690	1694	0	1	1	1	1	1	1	2	2
.23	1698	1702	1706	1710	1714	1718	1722	1726	1730	1734	0	1	1	1	1	1	1	2	2
.24	1738	1742	1746	1750	1754	1758	1762	1766	1770	1774	0	1	1	1	1	1	1	2	2

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.00	1816	1818	1820	1822	1824	1826	1828	1830	1832	1834	1836	1838	1840	1842	1844	1846	1848	1850	1852
.01	1854	1856	1858	1860	1862	1864	1866	1868	1870	1872	1874	1876	1878	1880	1882	1884	1886	1888	1890
.02	1897	1901	1905	1909	1913	1917	1921	1925	1929	1933	1936	1940	1944	1948	1952	1956	1960	1964	1968
.03	1945	1949	1953	1957	1961	1965	1969	1973	1977	1981	1985	1989	1993	1997	2001	2005	2009	2013	2017
.04	2037	2039	2043	2047	2051	2055	2059	2063	2067	2071	2075	2079	2083	2087	2091	2095	2099	2103	2107
.05	2084	2088	2092	2096	2100	2104	2108	2112	2116	2120	2124	2128	2132	2136	2140	2144	2148	2152	2156
.06	2186	2190	2194	2198	2202	2206	2210	2214	2218	2222	2226	2230	2234	2238	2242	2246	2250	2254	2258
.07	2286	2288	2292	2296	2300	2304	2308	2312	2316	2320	2324	2328	2332	2336	2340	2344	2348	2352	2356
.08	2393	2397	2401	2405	2409	2413	2417	2421	2425	2429	2433	2437	2441	2445	2449	2453	2457	2461	2465
.09	2685	2689	2693	2697	2701	2705	2709	2713	2717	2721	2725	2729	2733	2737	2741	2745	2749	2753	2757
.10	2805	2809	2813	2817	2821	2825	2829	2833	2837	2841	2845	2849	2853	2857	2861	2865	2869	2873	2877
.11	3148	3152	3156	3160	3164	3168	3172	3176	3180	3184	3188	3192	3196	3200	3204	3208	3212	3216	3220
.12	3155	3159	3163	3167	3171	3175	3179	3183	3187	3191	3195	3199	3203	3207	3211	3215	3219	3223	3227
.13	3233	3237	3241	3245	3249	3253	3257	3261	3265	3269	3273	3277	3281	3285	3289	3293	3297	3301	3305
.14	3244	3248	3252	3256	3260	3264	3268	3272	3276	3280	3284	3288	3292	3296	3300	3304	3308	3312	3316
.15	3255	3259	3263	3267	3271	3275	3279	3283	3287	3291	3295	3299	3303	3307	3311	3315	3319	3323	3327
.16	3264	3268	3272	3276	3280	3284	3288	3292	3296	3300	3304	3308	3312	3316	3320	3324	3328	3332	3336
.17	3273	3277	3281	3285	3289	3293	3297	3301	3305	3309	3313	3317	3321	3325	3329	3333	3337	3341	3345
.18	3288	3292	3296	3300	3304	3308	3312	3316	3320	3324	3328	3332	3336	3340	3344	3348	3352	3356	3360
.19	3293	3297	3301	3305	3309	3313	3317	3321	3325	3329	3333	3337	3341	3345	3349	3353	3357	3361	3365
.20	3306	3310	3314	3318	3322	3326	3330	3334	3338	3342	3346	3350	3354	3358	3362	3366	3370	3374	3378
.21	3313	3317	3321	3325	3329	3333	3337	3341	3345	3349	3353	3357	3361	3365	3369	3373	3377	3381	3385
.22	3322	3326	3330	3334	3338	3342	3346	3350	3354	3358	3362	3366	3370	3374	3378	3382	3386	3390	3394
.23	3331	3335	3339	3343	3347	3351	3355	3359	3363	3367	3371	3375	3379	3383	3387	3391	3395	3399	3403
.24	3340	3344	3348	3352	3356	3360	3364	3368	3372	3376	3380	3384	3388	3392	3396	3400	3404	3408	3412
.25	3349	3353	3357	3361	3365	3369	3373	3377	3381	3385	3389	3393	3397	3401	3405	3409	3413	3417	3421
.26	3358	3362	3366	3370	3374	3378	3382	3386	3390	3394	3398	3402	3406	3410	3414	3418	3422	3426	3430
.27	3367	3371	3375	3379	3383	3387	3391	3395	3400	3404	3408	3412	3416	3420	3424	3428	3432	3436	3440
.28	3376	3380	3384	3388	3392	3396	3400	3404	3408	3412	3416	3420	3424	3428	3432	3436	3440	3444	3448
.29	3385	3389	3393	3397	3401	3405	3409	3413	3417	3421	3425	3429	3433	3437	3441	3445	3449	3453	3457
.30	3394	3398	3402	3406	3410	3414	3418	3422	3426	3430	3434	3438	3442	3446	3450	3454	3458	3462	3466
.31	3403	3407	3411	3415	3419	3423	3427	3431	3435	3439	3443	3447	3451	3455	3459	3463	3467	3471	3475
.32	3412	3416	3420	3424	3428	3432	3436	3440	3444	3448	3452	3456	3460	3464	3468	3472	3476	3480	3484
.33	3421	3425	3429	3433	3437	3441	3445	3449	3453	3457	3461	3465	3469	3473	3477	3481	3485	3489	3493
.34	3430	3434	3438	3442	3446	3450	3454	3458	3462	3466	3470	3474	3478	3482	3486	3490	3494	3498	3502
.35	3439	3443	3447	3451	3455	3459	3463	3467	3471	3475	3479	3483	3487	3491	3495	3499	3503	3507	3511
.36	3448	3452	3456	3460	3464	3468	3472	3476	3480	3484	3488	3492	3496	3500	3504	3508	3512	3516	3520
.37	3457	3461	3465	3469	3473	3477	3481	3485	3489	3493	3497	3501	3505	3509	3513	3517	3521	3525	3529
.38	3466	3470	3474	3478	3482	3486	3490	3494	3498	3502	3506	3510	3514	3518	3522	3526	3530	3534	3538
.39	3475	3479	3483	3487	3491	3495	3499	3503	3507	3511	3515	3519	3523	3527	3531	3535	3539	3543	3547
.40	3484	3488	3492	3496	3500	3504	3508	3512	3516	3520	3524	3528	3532	3536	3540	3544	3548	3552	3556
.41																			

ANTI-LOGARITHMS

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
.50	3162	3170	3177	3184	3192	3199	3206	3214	3221	3228	1	1	2	3	4	4	5	6	7
.51	3236	3243	3251	3258	3266	3273	3281	3289	3296	3304	1	1	2	3	4	5	5	6	7
.52	3311	3319	3327	3334	3342	3350	3357	3365	3373	3381	1	1	2	2	3	4	5	6	7
.53	3388	3396	3404	3412	3420	3428	3436	3443	3451	3459	1	1	2	2	3	4	5	6	7
.54	3467	3483	3491	3499	3508	3516	3524	3532	3540	3548	1	1	2	2	3	4	5	6	7
.55	3548	3556	3565	3573	3581	3589	3597	3606	3614	3622	1	1	2	3	4	5	6	7	7
.56	3631	3639	3648	3656	3664	3673	3681	3690	3698	3707	1	1	2	3	3	4	5	6	7
.57	3715	3724	3733	3741	3750	3758	3767	3776	3784	3793	1	1	2	3	3	4	5	6	7
.58	3802	3811	3819	3828	3837	3846	3855	3864	3873	3882	1	1	2	3	4	4	5	6	7
.59	3890	3899	3908	3917	3926	3936	3945	3954	3963	3972	1	1	2	3	4	5	5	6	7
.60	3981	3990	3999	4009	4018	4027	4036	4046	4055	4064	1	1	2	3	4	5	6	6	7
.61	4074	4083	4093	4102	4111	4121	4130	4140	4150	4159	1	1	2	3	4	5	6	7	8
.62	4169	4178	4188	4198	4207	4217	4227	4236	4246	4256	1	1	2	3	4	5	6	7	8
.63	4266	4276	4285	4295	4305	4315	4325	4335	4345	4355	1	1	2	3	4	5	6	7	9
.64	4365	4375	4385	4395	4406	4416	4426	4436	4446	4457	1	1	2	3	4	5	6	7	9
.65	4467	4477	4487	4498	4508	4519	4529	4539	4550	4560	1	1	2	3	4	5	6	7	9
.66	4571	4581	4592	4603	4613	4624	4634	4645	4656	4667	1	1	2	3	4	5	6	7	10
.67	4677	4688	4699	4710	4721	4732	4742	4753	4764	4775	1	1	2	3	4	6	7	8	10
.68	4786	4797	4808	4819	4831	4842	4853	4864	4875	4887	1	1	2	3	4	6	7	8	10
.69	4898	4909	4920	4932	4943	4955	4966	4977	4989	5000	1	1	2	3	5	6	7	8	10
.70	5012	5023	5035	5047	5058	5070	5082	5093	5105	5117	1	1	2	4	5	6	7	8	11
.71	5129	5140	5152	5164	5176	5188	5200	5212	5224	5236	1	1	2	4	5	6	7	8	11
.72	5248	5260	5272	5284	5297	5309	5321	5333	5346	5358	1	1	2	4	5	6	7	8	11
.73	5370	5383	5395	5408	5420	5433	5445	5458	5470	5483	1	1	2	4	5	6	7	8	11
.74	5495	5508	5521	5534	5546	5559	5572	5585	5598	5610									

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
.75	5623	5636	5649	5662	5675	5689	5702	5715	5728	5741	1	1	2	3	4	5	7	8	9
.76	5754	5768	5781	5794	5808	5821	5834	5848	5861	5875	1	1	2	3	4	5	7	8	9
.77	5888	5902	5916	5929	5943	5957	5970	5984	5998	6012	1	1	2	3	4	6	7	8	10
.78	6026	6039	6053	6067	6081	6095	6109	6124	6138	6152	1	1	2	3	4	6	7	8	10
.79	6166	6180	6194	6209	6223	6237	6252	6266	6281	6295	1	1	2	3	4	6	7	9	10
.80	6310	6324	6339	6353	6368	6383	6397	6412	6427	6442	1	1	2	3	4	6	7	9	12
.81	6457	6471	6486	6501	6516	6531	6546	6561	6577	6592	1	1	2	3	5	6	8	9	12
.82	6607	6622	6637	6653	6668	6683	6699	6714	6730	6745	1	1	2	3	5	6	8	9	12
.83	6761	6776	6792	6808	6823	6839	6855	6871	6887	6902	1	1	2	3	5	6	8	9	12
.84	6918	6934	6950	6966	6982	6998	7015	7031	7047	7063	2	2	3	5	7	8	10	11	13
.85	7079	7096	7112	7129	7145	7161	7178	7194	7211	7228	2	2	3	5	7	8	10	12	15
.86	7244	7261	7278	7295	7311	7328	7345	7362	7379	7396	2	2	3	5	7	8	10	12	15
.87	7413	7430	7447	7464	7482	7499	7516	7534	7551	7568	2	2	3	5	7	9	10	12	15
.88	7586	7603	7621	7638	7656	7674	7691	7709	7727	7745	2	2	3	5	7	9	11	14	16
.89	7762	7780	7798	7816	7834	7852	7870	7889	7907	7925	2	2	3	5	7	9	11	14	16
.90	7943	7962	7980	7998	8017	8035	8054	8072	8091	8110	2	2	4	6	7	9	11	13	15
.91	8128	8147	8166	8185	8204	8222	8241	8260	8279	8299	2	2	4	6	8	9	11	13	15
.92	8318	8337	8356	8375	8395	8414	8433	8453	8472	8492	2	2	4	6	8	10	12	14	16
.93	8511	8531	8551	8570	8590	8610	8630	8650	8670	8690	2	2	4	6	8	10	12	14	16
.94	8710	8730	8750	8770	8790	8810	8831	8851	8872	8892	2	2	4	6	8	10	12	14	16
.95	8913	8933	8954	8974	8995	9016	9036	9057	9078	9099	2	2	4	6	8	10	12	14	16
.96	9120	9141	9162	9183	9204	9226	9247	9268	9290	9311	2	2	4	6	8	11	13	15	17
.97	9233	9254	9276	9297	9317	9337	9357	9377	9419	9441	9462	9484	9506	9528	9550	9577	9603	9630	9657
.98	9250	9272	9294	9316	9338	9360	9383	9403	9423	9443	9463	9483	9503	9523	9543	9563	9583	9603	9623
.99	9772	9795	9817	9840	9863	9886	9908	9931	9954	9977	2	2	4	6	7	9	11	14	16

LOG. SINES

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
0°	3.242	3.543	3.719	3.844	3.941	2.020	2.087	2.145	2.196	2.206	41	62	83	103	
1	2.2419	2.832	3.210	3.558	3.880	4.179	4.459	4.723	4.971	5.041	7041	8326	9315	48	81
2	2.5423	5.640	5.842	6.035	6.220	6.397	6.567	6.731	6.889	7.041	1381	1895	2153	3448	48
3	2.7188	7.330	7.468	7.602	7.731	7.857	7.979	8.098	8.213	8.326	10	19	29	38	48
4	2.8436	8.543	8.647	8.749	8.849	8.946	9.042	9.135	9.226	9.315	16	32	48	64	81
5	2.9403	9.489	9.573	9.655	9.736	9.816	9.894	9.970	0.046	0.120	13	26	39	53	66
6	2.0192	0.264	0.334	0.403	0.472	0.539	0.605	0.670	0.734	0.797	11	22	33	44	55
7	1.0859	0.920	0.981	1.040	1.099	1.157	1.214	1.271	1.326	1.381	10	19	29	38	48
8	1.1436	1.489	1.542	1.594	1.646	1.697	1.747	1.797	1.847	1.895	8	15	23	30	38
9	1.1943	1.991	2.038	2.085	2.131	2.176	2.221	2.266	2.310	2.353	8	15	23	30	38
10	1.2397	2.439	2.482	2.524	2.565	2.606	2.647	2.687	2.727	2.767	7	14	20	27	34
11	1.2806	2.845	2.883	2.921	2.959	2.997	3.034	3.070	3.107	3.143	6	12	19	25	31
12	1.3179	3.214	3.250	3.284	3.319	3.353	3.387	3.421	3.455	3.488	6	11	17	23	28
13	1.3521	3.554	3.586	3.618	3.650	3.682	3.713	3.745	3.775	3.806	5	11	16	21	26
14	1.3837	3.867	3.897	3.927	3.957	3.986	4.015	4.044	4.073	4.102	5	10	15	20	24
15	1.4130	4.158	4.186	4.214	4.242	4.269	4.296	4.323	4.350	4.377	5	9	14	18	23
16	1.4403	4.430	4.456	4.482	4.508	4.533	4.559	4.584	4.609	4.634	4	9	13	17	21
17	1.4659	4.684	4.709	4.733	4.757	4.781	4.805	4.829	4.853	4.876	4	8	12	16	20
18	1.4900	4.923	4.946	4.969	4.992	5.015	5.037	5.060	5.082	5.104	4	8	11	15	19
19	1.5126	5.148	5.170	5.192	5.213	5.233	5.256	5.278	5.299	5.320	4	7	11	14	18
20	1.5341	5.361	5.382	5.402	5.423	5.443	5.463	5.484	5.504	5.523	3	7	10	14	17
21	1.5543	5.563	5.583	5.602	5.621	5.641	5.660	5.679	5.698	5.717	3	6	7	10	13

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
22	1.5736	5.754	5.773	5.792	5.810	5.828	5.847	5.865	5.883	5.901	3	6	9	12	15
23	1.5919	5.937	5.954	5.972	5.990	6.007	6.024	6.042	6.059	6.076	3	6	9	12	15
24	1.6093	6.110	6.127	6.144	6.161	6.177	6.194	6.210	6.227	6.243	3	6	8	11	14
25	1.6259	6.276	6.292	6.308	6.324	6.340	6.356	6.371	6.387	6.403	3	5	8	11	13
26	1.6418	6.434	6.449	6.465	6.480	6.495	6.510	6.526	6.541	6.556	3	5	8	10	13
27	1.6570	6.585	6.600	6.615	6.629	6.644	6.659	6.673	6.687	6.702	2	5	7	10	12
28	1.6716	6.730	6.744	6.759	6.773	6.787	6.801	6.814	6.828	6.842	2	5	7	9	12
29	1.6856	6.869	6.883	6.896	6.910	6.923	6.937	6.950	6.963	6.977	2	4	7	9	11
30	1.6990	7.003	7.016	7.029	7.042	7.055	7.068	7.080	7.093	7.106	2	4	6	9	11
31	1.7118	7.131	7.144	7.156	7.168	7.181	7.193	7.205	7.218	7.230	2	4	6	8	10
32	1.7242	7.254	7.266	7.278	7.290	7.302	7.314	7.326	7.338	7.349	2	4	6	8	10
33	1.7361	7.373	7.384	7.396	7.407	7.419	7.430	7.442	7.453	7.464	2	4	6	8	10
34	1.7476	7.487	7.498	7.509	7.520	7.531	7.542	7.553	7.564	7.575	2	4	6	7	9
35	1.7586	7.597	7.607	7.618	7.629	7.640	7.650	7.661	7.671	7.682	2	4	5	7	9
36	1.7692	7.703	7.713	7.723	7.734	7.744	7.754	7.764	7.774	7.785	2	3	5	7	9
37	1.7795	7.805	7.815	7.825	7.835	7.844	7.854	7.864	7.874	7.884	2	3	5	7	9
38	1.7893	7.903	7.913	7.922	7.932	7.941	7.951	7.960	7.970	7.979	2	3	5	6	8
39	1.7989	7.998	8.007	8.017	8.026	8.035	8.044	8.053	8.063	8.072	2	3	5	6	8
40	1.8081	8.090	8.099	8.108	8.117	8.125	8.134	8.143	8.152	8.161	1	3	4	6	7
41	1.8169	8.178	8.187	8.195	8.204	8.213	8.221	8.230	8.238	8.247	1	3	4	6	7
42	1.8255	8.264	8.274	8.280	8.289	8.297	8.305	8.313	8.322	8.330	1	3	4	6	7
43	1.8338	8.346	8.354	8.362	8.370	8.378	8.386	8.394	8.402	8.410	1	3	4	5	7
44	1.8418	8.426	8.433	8.441	8.449	8.457	8.464	8.472	8.480	8.487	1	3	4	5	6
	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'

The black type indicates that the integer changes.

LOG. SINES

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
45°	1.8495	8502	8510	8517	8525	8532	8540	8547	8555	8562	1	2	4	5	6
46	1.8569	8577	8584	8591	8598	8606	8613	8620	8627	8634	1	2	4	5	6
47	1.8641	8648	8655	8662	8669	8676	8683	8690	8697	8704	1	2	3	4	5
48	1.8711	8718	8724	8731	8738	8745	8751	8758	8765	8771	1	2	3	4	5
49	1.8778	8784	8791	8797	8804	8810	8817	8823	8830	8836	1	2	3	4	5
50	1.8843	8849	8855	8862	8868	8874	8880	8887	8893	8899	1	2	3	4	5
51	1.8905	8911	8917	8923	8929	8935	8941	8947	8953	8959	1	2	3	4	5
52	1.8965	8971	8977	8983	8989	8995	9000	9006	9012	9018	1	2	3	4	5
53	1.9023	9029	9035	9041	9046	9052	9057	9063	9069	9074	1	2	3	4	5
54	1.9080	9085	9091	9096	9101	9107	9112	9118	9123	9128	1	2	3	4	5
55	1.9134	9139	9144	9149	9155	9160	9165	9170	9175	9181	1	2	3	4	5
56	1.9186	9191	9196	9201	9206	9211	9216	9221	9226	9231	1	2	3	4	5
57	1.9236	9241	9246	9251	9255	9260	9265	9270	9275	9279	1	2	3	4	5
58	1.9284	9289	9294	9298	9303	9308	9312	9317	9322	9326	1	2	3	4	5
59	1.9331	9335	9340	9344	9349	9353	9358	9362	9367	9371	1	2	3	4	5
60	1.9375	9380	9384	9388	9393	9397	9401	9406	9410	9414	1	1	2	3	4
61	1.9418	9422	9427	9431	9435	9439	9443	9447	9451	9455	1	1	2	3	4
62	1.9459	9463	9467	9471	9475	9479	9483	9487	9491	9495	1	1	2	3	4
63	1.9499	9503	9506	9510	9514	9518	9522	9525	9529	9533	1	1	2	3	4
64	1.9537	9540	9544	9548	9551	9555	9558	9562	9566	9569	1	1	2	3	4
65	1.9573	9576	9580	9583	9587	9590	9594	9597	9601	9604	1	1	2	3	4
66	1.9607	9611	9614	9617	9621	9624	9627	9631	9634	9637	1	1	2	3	4

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
67	1.9640	9643	9647	9650	9653	9656	9659	9662	9665	9666	1	2	2	2	2
68	1.9672	9675	9678	9681	9684	9687	9690	9693	9696	9699	0	1	1	1	1
69	1.9702	9704	9707	9710	9713	9716	9719	9722	9724	9727	0	1	1	1	1
70	1.9730	9733	9735	9738	9741	9743	9746	9749	9751	9754	0	1	1	1	1
71	1.9757	9759	9762	9764	9767	9770	9772	9775	9777	9780	0	1	1	1	1
72	1.9782	9785	9787	9789	9792	9794	9797	9799	9801	9804	0	1	1	1	1
73	1.9806	9808	9811	9813	9815	9817	9820	9822	9824	9826	0	1	1	1	1
74	1.9828	9831	9833	9835	9837	9839	9841	9843	9845	9847	0	1	1	1	1
75	1.9849	9851	9853	9855	9857	9859	9861	9863	9865	9867	0	1	1	1	1
76	1.9869	9871	9873	9875	9876	9878	9880	9882	9884	9885	0	1	1	1	1
77	1.9887	9889	9891	9893	9894	9896	9897	9899	9901	9902	0	1	1	1	1
78	1.9904	9906	9907	9909	9910	9912	9913	9915	9916	9918	0	1	1	1	1
79	1.9919	9921	9922	9924	9925	9927	9928	9929	9931	9932	0	1	1	1	1
80	1.9934	9935	9936	9937	9939	9940	9941	9943	9944	9945	0	0	1	1	1
81	1.9946	9947	9949	9950	9951	9952	9953	9954	9955	9956	0	0	1	1	1
82	1.9958	9959	9960	9961	9962	9963	9964	9965	9966	9967	0	0	0	0	0
83	1.9968	9968	9969	9970	9971	9972	9973	9974	9975	9975	0	0	0	0	0
84	1.9976	9977	9978	9979	9980	9981	9982	9983	9984	9983	0	0	0	0	0
85	1.9983	9984	9985	9986	9987	9988	9989	9990	9991	9992	0	0	0	0	0
86	1.9989	9990	9990	9991	9991	9992	9992	9993	9993	9993	0	0	0	0	0
87	1.9994	9994	9994	9995	9995	9996	9996	9996	9996	9997	0	0	0	0	0
88	1.9997	9998	9998	9998	9998	9998	9999	9999	9999	9999	0	0	0	0	0
89	1.9999	9999	0000	0000	0000	0000	0000	0000	0000	0000	0	0	0	0	0

The black type indicates that the integer changes.

LOG. COSINES

SUBTRACT

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
0°	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.9999	0.9998	0.9998	0.9998	0.9998
1	1.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9999	0.9998	0.9998	0.9998	0.9998
2	1.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9996	0.9996	0.9996	0.9996	0.9995	0.9995	0.9995	0.9995	0.9994
3	1.9994	0.9994	0.9994	0.9994	0.9994	0.9993	0.9993	0.9992	0.9992	0.9992	0.9991	0.9991	0.9991	0.9991	0.9990
4	1.9989	0.9989	0.9988	0.9988	0.9987	0.9987	0.9986	0.9986	0.9985	0.9985	0.9985	0.9985	0.9985	0.9984	0.9984
5	1.9983	0.9983	0.9982	0.9981	0.9981	0.9974	0.9973	0.9972	0.9971	0.9970	0.9969	0.9969	0.9969	0.9969	0.9968
6	1.9976	0.9976	0.9975	0.9975	0.9975	0.9966	0.9965	0.9964	0.9963	0.9962	0.9961	0.9960	0.9959	0.9959	0.9959
7	1.9968	0.9968	0.9967	0.9967	0.9966	0.9965	0.9965	0.9964	0.9963	0.9962	0.9961	0.9960	0.9959	0.9959	0.9959
8	1.9958	0.9958	0.9956	0.9956	0.9955	0.9954	0.9953	0.9952	0.9951	0.9950	0.9949	0.9949	0.9947	0.9947	0.9947
9	1.9946	0.9945	0.9944	0.9944	0.9943	0.9941	0.9941	0.9940	0.9939	0.9937	0.9936	0.9935	0.9935	0.9935	0.9935
10	1.9934	0.9932	0.9931	0.9929	0.9928	0.9927	0.9925	0.9924	0.9923	0.9922	0.9921	0.9921	0.9920	0.9920	0.9920
11	1.9919	0.9918	0.9916	0.9916	0.9915	0.9913	0.9912	0.9910	0.9909	0.9907	0.9906	0.9906	0.9906	0.9906	0.9906
12	1.9904	0.9902	0.9902	0.9901	0.9899	0.9897	0.9896	0.9894	0.9892	0.9891	0.9889	0.9889	0.9889	0.9889	0.9889
13	1.9887	0.9885	0.9884	0.9882	0.9882	0.9880	0.9878	0.9876	0.9875	0.9873	0.9871	0.9871	0.9871	0.9871	0.9871
14	1.9869	0.9867	0.9865	0.9863	0.9863	0.9861	0.9859	0.9857	0.9855	0.9853	0.9851	0.9851	0.9851	0.9851	0.9851
15	1.9849	0.9847	0.9845	0.9843	0.9841	0.9839	0.9837	0.9835	0.9833	0.9831	0.9831	0.9831	0.9831	0.9831	0.9831
16	1.9828	0.9826	0.9824	0.9822	0.9820	0.9817	0.9815	0.9813	0.9811	0.9808	0.9808	0.9808	0.9808	0.9808	0.9808
17	1.9806	0.9804	0.9804	0.9801	0.9799	0.9797	0.9794	0.9792	0.9789	0.9787	0.9785	0.9785	0.9785	0.9785	0.9785
18	1.9782	0.9780	0.9779	0.9775	0.9772	0.9770	0.9767	0.9764	0.9762	0.9759	0.9759	0.9759	0.9759	0.9759	0.9759
19	1.9757	0.9754	0.9751	0.9749	0.9746	0.9743	0.9741	0.9738	0.9735	0.9733	0.9733	0.9733	0.9733	0.9733	0.9733
20	1.9730	0.9727	0.9724	0.9722	0.9719	0.9716	0.9713	0.9710	0.9707	0.9704	0.9704	0.9704	0.9704	0.9704	0.9704
21	1.9702	0.9699	0.9696	0.9693	0.9693	0.9690	0.9687	0.9684	0.9681	0.9678	0.9675	0.9675	0.9675	0.9675	0.9675

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
22	1.9672	0.9669	0.9666	0.9662	0.9659	0.9656	0.9653	0.9650	0.9647	0.9643	1	1	1	1	1
23	1.9640	0.9637	0.9634	0.9631	0.9627	0.9624	0.9621	0.9617	0.9614	0.9611	1	1	1	1	1
24	1.9607	0.9604	0.9601	0.9597	0.9594	0.9590	0.9587	0.9583	0.9580	0.9576	1	1	1	1	1
25	1.9573	0.9569	0.9566	0.9562	0.9558	0.9555	0.9551	0.9548	0.9544	0.9540	1	1	1	1	1
26	1.9537	0.9533	0.9529	0.9525	0.9522	0.9518	0.9514	0.9510	0.9506	0.9503	1	1	1	1	1
27	1.9499	0.9495	0.9491	0.9487	0.9483	0.9479	0.9475	0.9471	0.9467	0.9463	1	1	1	1	1
28	1.9459	0.9455	0.9451	0.9447	0.9443	0.9439	0.9435	0.9431	0.9427	0.9422	1	1	1	1	1
29	1.9418	0.9414	0.9410	0.9406	0.9401	0.9397	0.9393	0.9388	0.9384	0.9380	1	1	1	1	1
30	1.9375	0.9371	0.9367	0.9362	0.9358	0.9353	0.9349	0.9344	0.9340	0.9335	1	1	1	1	1
31	1.9331	0.9326	0.9322	0.9317	0.9312	0.9308	0.9303	0.9298	0.9294	0.9289	1	1	1	1	1
32	1.9284	0.9279	0.9275	0.9270	0.9265	0.9260	0.9255	0.9250	0.9246	0.9241	1	1	1	1	1
33	1.9236	0.9231	0.9226	0.9221	0.9216	0.9211	0.9206	0.9201	0.9196	0.9191	1	1	1	1	1
34	1.9186	0.9181	0.9175	0.9170	0.9165	0.9160	0.9155	0.9149	0.9144	0.9139	1	1	1	1	1
35	1.9134	0.9128	0.9123	0.9118	0.9112	0.9107	0.9101	0.9096	0.9091	0.9085	1	1	1	1	1
36	1.9080	0.9074	0.9069	0.9063	0.9057	0.9052	0.9046	0.9041	0.9035	0.9029	1	1	1	1	1
37	1.9023	0.9018	0.9012	0.9006	0.9000	0.8995	0.8989	0.8983	0.8977	0.8971	1	1	1	1	1
38	1.8963	0.8959	0.8953	0.8947	0.8941	0.8935	0.8929	0.8923	0.8917	0.8911	1	1	1	1	1
39	1.8905	0.8899	0.8893	0.8887	0.8880	0.8874	0.8868	0.8862	0.8855	0.8849	1	1	1	1	1
40	1.8843	0.8836	0.8830	0.8823	0.8817	0.8810	0.8804	0.8797	0.8791	0.8784	1	1	1	1	1
41	1.8778	0.8771	0.8765	0.8758	0.8751	0.8745	0.8738	0.8731	0.8724	0.8718	1	1	1	1	1
42	1.8711	0.8704	0.8697	0.8690	0.8683	0.8676	0.8669	0.8662	0.8655	0.8648	1	1	1	1	1
43	1.8641	0.8634	0.8627	0.8620	0.8613	0.8606	0.8598	0.8591	0.8584	0.8577	1	1	1	1	1
44	1.8569	0.8562	0.8555	0.8547	0.8540	0.8532	0.8525	0.8517	0.8510	0.8502	1	1	1	1	1
	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'

The black type indicates that the integer changes.

LOG. COSINES

SUBTRACT

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1°	2°	3°	4°	5°
45°	1.8495	8487	8460	8472	8464	8457	8449	8441	8433	8426	1	3	4	5	6
46	1.8418	8410	8402	8394	8386	8378	8370	8362	8354	8346	1	3	4	5	7
47	1.8338	8330	8322	8313	8305	8297	8289	8280	8272	8264	1	3	4	6	7
48	1.8255	8247	8238	8230	8221	8213	8204	8195	8187	8178	1	3	4	6	7
49	1.8169	8161	8152	8143	8134	8125	8117	8108	8099	8090	1	3	4	6	7
50	1.8081	8072	8063	8053	8044	8035	8026	8017	8007	7998	2	3	5	6	8
51	1.7999	7979	7970	7960	7951	7941	7932	7922	7913	7903	2	3	5	6	8
52	1.7893	7884	7874	7864	7854	7844	7835	7825	7815	7805	2	3	5	7	8
53	1.7795	7785	7774	7764	7754	7744	7734	7723	7713	7703	2	3	5	7	9
54	1.7692	7682	7671	7661	7650	7640	7629	7618	7607	7597	2	4	5	7	9
55	1.7586	7575	7564	7553	7542	7531	7520	7509	7498	7487	2	4	5	7	9
56	1.7476	7464	7453	7442	7430	7419	7407	7396	7384	7373	2	4	6	8	10
57	1.7361	7349	7338	7326	7314	7302	7290	7278	7266	7254	2	4	6	8	10
58	1.7242	7230	7218	7205	7193	7181	7168	7156	7144	7131	2	4	6	8	10
59	1.7118	7106	7093	7080	7068	7055	7042	7029	7016	7003	2	4	6	9	11
60	1.6990	6977	6963	6950	6937	6923	6910	6896	6883	6869	2	4	7	9	11
61	1.6856	6842	6828	6814	6801	6787	6773	6759	6744	6730	2	5	7	9	12
62	1.6716	6702	6687	6673	6659	6644	6629	6615	6600	6585	2	5	7	10	12
63	1.6570	6556	6541	6526	6510	6495	6480	6465	6449	6434	2	5	8	10	13
64	1.6418	6403	6387	6371	6356	6340	6324	6308	6292	6276	3	5	8	11	13
65	1.6259	6243	6227	6210	6194	6177	6161	6144	6127	6110	3	6	8	11	14
66	1.6093	6076	6059	6039	6024	6007	5990	5972	5954	5937	3	6	9	11	15

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1°	2°	3°	4°	5°
67	1.5919	5901	5883	5865	5847	5828	5810	5792	5773	5754	3	6	9	12	15
68	1.5736	5717	5698	5679	5660	5641	5621	5602	5583	5563	3	6	9	12	16
69	1.5543	5523	5504	5484	5463	5443	5423	5402	5382	5361	3	7	10	14	17
70	1.5341	5320	5299	5278	5256	5235	5213	5192	5170	5148	4	7	11	14	18
71	1.5126	5104	5082	5060	5037	5015	4992	4969	4946	4923	4	8	11	15	19
72	1.4900	4876	4853	4829	4805	4781	4757	4733	4709	4684	4	8	12	16	20
73	1.4659	4634	4609	4584	4559	4533	4508	4482	4456	4430	4	9	13	17	21
74	1.4403	4377	4350	4323	4296	4269	4242	4214	4186	4158	5	9	14	18	23
75	1.4130	4102	4073	4044	4015	3986	3957	3927	3897	3867	5	10	15	20	24
76	1.3837	3806	3775	3745	3713	3682	3650	3618	3586	3554	5	11	16	21	26
77	1.3521	3488	3455	3421	3387	3353	3319	3284	3250	3214	6	11	17	23	28
78	1.3179	3143	3107	3070	3034	2997	2959	2921	2883	2845	6	12	19	25	31
79	1.2806	2767	2727	2687	2647	2606	2565	2524	2482	2439	7	14	20	27	34
80	1.2397	2353	2310	2266	2221	2176	2131	2085	2038	1991	8	15	23	30	38
81	1.1943	1895	1847	1797	1747	1697	1646	1594	1542	1489	8	17	25	34	42
82	1.1436	1381	1326	1271	1214	1157	1099	1040	981	920	10	19	29	38	48
83	1.0859	0797	0734	0670	0605	0539	0472	0403	0334	0264	11	22	33	44	55
84	1.0192	0120	0046	9970	9894	9816	9736	9655	9573	9489	13	26	39	53	66
85	2.9403	9315	9226	9135	9042	8946	8849	8749	8647	8543	16	32	48	64	81
86	2.8436	8326	8213	8098	7979	7857	7731	7602	7468	7330	21	41	62	83	103
87	2.7188	7041	6889	6731	6367	6397	6220	6035	5842	5640	Differences untrustworthy here				
88	2.5428	5206	4971	4723	4459	4179	3880	3558	3210	2832	3.543				
89	2.242	2.196	2.145	2.087	2.020	3.941	3.844	3.719	3.543	3.242					
	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'					

The black type indicates that the integer changes.

LOG. TANGENTS

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1°	2°	3°	4°	5°
0°	3.242	3.543	3.719	3.844	3.941	3.994	4.020	4.087	4.145	4.196					
1	— ∞	2.2419	2.5431	2.833	3.223	3.559	3.881	4.181	4.461	4.725	5.208				
2	2.5431	5.643	5845	6038	6223	6401	6571	6736	6894	7046	7.196				
3	2.7194	7.337	7475	7609	7739	7865	7988	8107	8223	8336	21	42	63	83	104
4	2.8446	8554	8659	8762	8862	8960	9056	9150	9241	9331	16	32	48	65	81
5	2.9420	9506	9591	9674	9756	9836	9915	9992	0.068	0.143	13	26	40	53	66
6	1.0216	0.289	0.360	0.430	0.499	0.567	0.633	0.699	0.764	0.828	11	22	34	45	56
7	1.0891	0.954	1.015	1.076	1.135	1.194	1.252	1.310	1.367	1.423	10	20	29	39	43
8	1.1478	1.533	1.587	1.640	1.693	1.745	1.797	1.848	1.898	1.948	9	17	26	35	39
9	1.1997	2.046	2.094	2.142	2.189	2.236	2.282	2.328	2.374	2.419	8	16	23	31	39
10	1.2463	2.507	2.551	2.594	2.637	2.680	2.722	2.764	2.805	2.846	7	14	21	28	35
11	1.2887	2.927	2.967	3.006	3.046	3.085	3.123	3.162	3.200	3.237	6	13	19	26	32
12	1.3275	3.312	3.349	3.385	3.422	3.458	3.493	3.529	3.564	3.599	6	12	18	24	30
13	1.3634	3.668	3.702	3.736	3.770	3.804	3.837	3.870	3.903	3.935	6	11	17	22	28
14	1.3968	4.000	4.032	4.064	4.095	4.127	4.158	4.189	4.220	4.250	5	10	16	21	26
15	1.4281	4.311	4.341	4.371	4.400	4.430	4.459	4.488	4.517	4.546	5	10	15	20	25
16	1.4575	4.603	4.632	4.660	4.688	4.716	4.744	4.771	4.799	4.826	5	9	14	19	23
17	1.4853	4.880	4.907	4.934	4.961	4.987	5.014	5.040	5.066	5.092	4	9	13	18	22
18	1.5118	5.143	5.169	5.195	5.220	5.245	5.270	5.295	5.320	5.345	4	8	13	17	21
19	1.5370	5.394	5.419	5.443	5.467	5.491	5.516	5.539	5.563	5.587	4	8	12	16	20
20	1.5611	5.634	5.658	5.681	5.704	5.727	5.750	5.773	5.796	5.819	4	8	12	15	19
21	1.5842	5.864	5.887	5.909	5.932	5.954	5.976	5.998	6.020	6.042	4	7	11	15	19

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1°	2°	3°	4°	5°
22	1.6064	6.086	6.108	6.129	6.151	6.172	6.194	6.215	6.236	6.257	4	7	11	14	18
23	1.6279	6.300	6.321	6.341	6.362	6.383	6.404	6.424	6.445	6.465	3	7	10	14	17
24	1.6486	6.506	6.527	6.547	6.567	6.587	6.607	6.627	6.647	6.667	3	7	10	13	17
25	1.6687	6.706	6.726	6.746	6.765	6.785	6.804	6.824	6.843	6.863	3	7	10	13	16
26	1.6882	6.901	6.920	6.939	6.958	6.977	6.996	7.015	7.034	7.053	3	6	9	12	15
27	1.7072	7.090	7.109	7.128	7.146	7.165	7.183	7.202	7.220	7.238	3	6	9	12	15
28	1.7257	7.275	7.293	7.311	7.330	7.348	7.366	7.384	7.402	7.420	3	6	9	12	15
29	1.7438	7.455	7.473	7.491	7.509	7.526	7.544	7.562	7.579	7.597	3	6	9	12	15
30	1.7614	7.632	7.649	7.667	7.684	7.701	7.719	7.736	7.753	7.771	3	6	9	12	14
31	1.7788	7.805	7.822	7.839	7.856	7.873	7.890	7.907	7.924	7.941	3	6	9	11	14
32	1.7958	7.975	7.992	8.008	8.025	8.042	8.059	8.075	8.092	8.109	3	6	8	11	14
33	1.8125	8.142	8.158	8.175	8.191	8.208	8.224	8.241	8.257	8.274	3	5	8	11	14
34	1.8290	8.306	8.323	8.339	8.355	8.371	8.388	8.404	8.420	8.436	3	5	8	11	14
35	1.8452	8.468	8.484	8.501	8.517	8.533	8.549	8.565	8.581	8.597	3	5	8	11	13
36	1.8613	8.629	8.644	8.660	8.676	8.692	8.708	8.724	8.740	8.755	3	5	8	11	13
37	1.8771	8.787	8.803	8.818	8.834	8.850	8.865	8.881	8.897	8.912	3	5	8	10	13
38	1.8928	8.944	8.964	8.975	8.990	9.006	9.022	9.037	9.053	9.068	3	5	8	10	13
39	1.9084	9.099	9.115	9.130	9.146	9.161	9.176	9.192	9.203	9.223	3	5	8	10	13
40	1.9238	9.254	9.269	9.284	9.300	9.315	9.330	9.346	9.361	9.376	3	5	8	10	13
41	1.9392	9.407	9.422	9.438	9.453	9.468	9.483	9.499	9.514	9.529	3	5	8	10	13
42	1.9544	9.560	9.575	9.590	9.605	9.621	9.636	9.651	9.666	9.681	3	5	8	10	13
43	1.9697	9.712	9.727	9.742	9.757	9.772	9.788	9.803	9.818	9.833	3	5	8	10	13
44	1.9848	9.864	9.879	9.894	9.909	9.924	9.939	9.955	9.970	9.985	3	5	8	10	13
	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1°	2°	3°	4°	5°

The black type indicates that the integer changes.

LOG. TANGENTS

	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°
45°	0.0000	0.015	0.030	0.045	0.061	0.076	0.091	0.106	0.121	0.136	3	5	8	10	13
46	0.0152	0.0167	0.0182	0.0197	0.0212	0.0228	0.0243	0.0258	0.0273	0.0288	3	5	8	10	13
47	0.0303	0.0319	0.0334	0.0349	0.0364	0.0379	0.0395	0.0410	0.0425	0.0440	3	5	8	10	13
48	0.0456	0.0471	0.0486	0.0501	0.0517	0.0532	0.0547	0.0562	0.0578	0.0593	3	5	8	10	13
49	0.0608	0.0624	0.0639	0.0654	0.0670	0.0685	0.0700	0.0716	0.0731	0.0746	3	5	8	10	13
50	0.0762	0.0777	0.0793	0.0808	0.0824	0.0839	0.0854	0.0870	0.0885	0.0901	3	5	8	10	13
51	0.0916	0.0932	0.0947	0.0963	0.0978	0.0994	0.1010	0.1025	0.1041	0.1056	3	5	8	10	13
52	0.1072	0.1088	0.1103	0.1119	0.1135	0.1150	0.1166	0.1182	0.1197	0.1213	3	5	8	10	13
53	0.1229	0.1245	0.1260	0.1276	0.1292	0.1308	0.1324	0.1340	0.1356	0.1371	3	5	8	11	13
54	0.1387	0.1403	0.1419	0.1435	0.1451	0.1467	0.1483	0.1499	0.1516	0.1532	3	5	8	11	13
55	0.1548	0.1564	0.1580	0.1596	0.1612	0.1629	0.1645	0.1661	0.1677	0.1694	3	5	8	11	14
56	0.1710	0.1726	0.1743	0.1759	0.1776	0.1792	0.1809	0.1825	0.1842	0.1858	3	5	8	11	14
57	0.1875	0.1891	0.1908	0.1925	0.1941	0.1958	0.1975	0.1992	0.2008	0.2025	3	6	8	11	14
58	0.2042	0.2059	0.2076	0.2093	0.2110	0.2127	0.2144	0.2161	0.2178	0.2195	3	6	9	11	14
59	0.2212	0.2229	0.2247	0.2264	0.2281	0.2299	0.2316	0.2333	0.2351	0.2368	3	6	9	12	14
60	0.2386	0.2403	0.2421	0.2438	0.2456	0.2474	0.2491	0.2509	0.2527	0.2545	3	6	9	12	15
61	0.2562	0.2580	0.2598	0.2616	0.2634	0.2652	0.2670	0.2689	0.2707	0.2725	3	6	9	12	15
62	0.2743	0.2762	0.2780	0.2798	0.2817	0.2835	0.2854	0.2872	0.2891	0.2910	3	6	9	12	15
63	0.2928	0.2947	0.2966	0.2985	0.3004	0.3023	0.3042	0.3061	0.3080	0.3099	3	6	9	13	16
64	0.3118	0.3137	0.3157	0.3176	0.3196	0.3215	0.3235	0.3254	0.3274	0.3294	3	7	10	13	16
65	0.3313	0.3333	0.3353	0.3373	0.3393	0.3413	0.3433	0.3453	0.3473	0.3494	3	7	10	13	17
66	0.3514	0.3535	0.3555	0.3576	0.3596	0.3617	0.3638	0.3659	0.3679	0.3700	3	7	10	14	17

	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°
67	0.3721	0.3936	0.4158	0.4181	0.4204	0.4227	0.4250	0.4273	0.4296	0.4319	3849	3871	3892	3914	4
68	0.4158	0.4181	0.4204	0.4227	0.4250	0.4273	0.4296	0.4319	0.4342	0.4366	4046	4091	4113	4136	4
69	0.4589	0.4413	0.4437	0.4461	0.4484	0.4509	0.4533	0.4557	0.4581	0.4606	4275	4298	4322	4346	4
70	0.4882	0.4908	0.4934	0.4960	0.4986	0.5013	0.5039	0.5066	0.5093	0.5120	4470	4505	4540	4575	4
71	0.5147	0.5174	0.5201	0.5229	0.5256	0.5284	0.5312	0.5340	0.5368	0.5397	4666	4701	4736	4771	4
72	0.5425	0.5454	0.5483	0.5512	0.5541	0.5570	0.5600	0.5629	0.5659	0.5689	4861	4906	4941	4976	4
73	0.5719	0.5750	0.5780	0.5811	0.5842	0.5873	0.5905	0.5936	0.5968	0.6000	5066	5101	5136	5171	4
74	0.6032	0.6065	0.6097	0.6130	0.6163	0.6196	0.6230	0.6264	0.6298	0.6332	5261	5306	5351	5396	4
75	0.6325	0.6366	0.6401	0.6436	0.6471	0.6507	0.6542	0.6578	0.6615	0.6651	5461	5506	5551	5596	4
76	0.6725	0.6763	0.6800	0.6838	0.6877	0.6915	0.6954	0.6994	0.7033	0.7073	5656	5701	5746	5791	4
77	0.7113	0.7154	0.7195	0.7236	0.7278	0.7320	0.7363	0.7406	0.7449	0.7493	5856	5901	5946	6001	4
78	0.7537	0.7581	0.7626	0.7672	0.7718	0.7764	0.7810	0.7858	0.7906	0.7954	6056	6101	6146	6191	4
79	0.8003	0.8052	0.8102	0.8152	0.8203	0.8255	0.8307	0.8360	0.8413	0.8467	6256	6301	6356	6411	4
80	0.8522	0.8577	0.8633	0.8690	0.8748	0.8806	0.8865	0.8924	0.8985	0.9046	6456	6511	6566	6621	4
81	0.9109	0.9172	0.9236	0.9301	0.9367	0.9433	0.9501	0.9570	0.9640	0.9711	6656	6711	6776	6841	4
82	0.9784	0.9857	0.9932	0.0008	0.0085	0.0164	0.0244	0.0326	0.0409	0.0494	6856	6911	6976	7041	4
83	1.0580	0.669	0.759	0.850	0.944	1.040	1.138	1.238	1.341	1.446	7056	7111	7216	7321	4
84	1.1554	1.664	1.777	1.893	2.012	2.135	2.261	2.391	2.525	2.663	7256	7371	7506	7631	4
85	1.2806	2.954	3.106	3.264	3.429	3.599	3.777	3.962	4.155	4.357	7456	7571	7706	7831	4
86	1.4569	4.792	5.027	5.525	5.539	5.819	6.119	6.441	6.789	7.167	7636	7751	7876	8001	4
87	1.804	1.804	1.855	1.980	2.156	2.281	2.457	2.758	2.758	2.758	8056	8171	8286	8401	4
88	1.758	1.758	1.804	1.804	1.804	1.804	1.804	1.804	1.804	1.804	8171	8286	8401	8516	4
89	0.9784	0.9857	0.9932	0.0008	0.0085	0.0164	0.0244	0.0326	0.0409	0.0494	8171	8286	8401	8516	4
	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°

Differences
untrustworthy
here

The black type indicates that the integer changes.

LOG. COTANGENTS

SUBTRACT

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
0°	+∞	2.758	2.457	2.281	2.156	2.059	1.980	1.913	1.855	1.804	1.792	1.757	1.717	1.677	1.637
1	1.7581	7167	6789	6441	6119	5819	5339	5275	5027	4792	4427	4164	3897	3632	3377
2	1.4569	4357	4155	3777	3599	3429	3264	3106	2954	2702	2451	2200	1950	1700	1450
3	1.2806	2663	2525	2391	2261	2135	2012	1893	1777	1664	1521	1379	1237	1095	953
4	1.1554	1446	1341	1238	1138	1040	9444	8850	0759	0669	16	32	48	65	81
5	1.0580	0494	0409	0326	0244	0164	0085	0008	9932	9857	13	26	40	53	66
6	0.9784	9711	9640	9570	9501	9433	9367	9301	9236	9172	11	22	34	45	56
7	0.9109	9046	8985	8924	8865	8806	8748	8690	8633	8577	10	20	29	39	49
8	0.8522	8467	8413	8360	8307	8255	8203	8152	8102	8052	9	17	26	35	43
9	0.8003	7954	7906	7858	7811	7764	7718	7672	7626	7581	8	16	23	31	39
10	0.7537	7493	7449	7406	7363	7320	7278	7236	7195	7154	7	14	21	28	35
11	0.7113	7073	7033	6994	6954	6915	6877	6838	6800	6763	6	13	19	26	32
12	0.6725	6688	6631	6578	6542	6516	6471	6437	6401	6436	6	12	18	24	30
13	0.6366	6332	6264	6230	6196	6163	6130	6097	6065	6034	6	11	17	22	28
14	0.6032	6000	5968	5936	5905	5873	5842	5811	5780	5750	5	10	16	21	26
15	0.5719	5689	5659	5629	5600	5570	5541	5512	5483	5454	5	10	15	20	25
16	0.5425	5397	5368	5340	5312	5284	5256	5229	5201	5174	5	9	14	19	23
17	0.5147	5120	5093	5066	5039	5013	4986	4960	4934	4908	4	9	13	18	22
18	0.4882	4857	4831	4805	4780	4755	4730	4705	4680	4655	4	8	13	17	21
19	0.4630	4606	4581	4557	4533	4509	4484	4461	4437	4413	4	8	12	16	20
20	0.4389	4366	4342	4319	4296	4273	4250	4227	4204	4181	4	8	12	15	19
21	0.4158	4136	4113	4091	4068	4046	4024	4002	3980	3958	4	7	11	15	19

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
22	0.3936	3914	3892	3871	3849	3828	3806	3785	3764	3743	4	7	11	14	18
23	0.3721	3700	3679	3659	3638	3617	3596	3576	3555	3535	3	7	10	13	17
24	0.3514	3494	3473	3453	3433	3413	3393	3373	3353	3333	3	7	10	13	17
25	0.3313	3294	3274	3254	3235	3215	3196	3176	3157	3137	3	7	10	13	16
26	0.3118	3099	3080	3061	3042	3023	3004	2985	2966	2947	3	6	9	13	16
27	0.2928	2910	2891	2872	2854	2835	2817	2798	2780	2762	3	6	9	12	15
28	0.2743	2725	2707	2689	2670	2652	2634	2616	2598	2580	3	6	9	12	15
29	0.2562	2545	2527	2509	2491	2474	2456	2438	2421	2403	3	6	9	12	15
30	0.2386	2368	2351	2333	2316	2299	2281	2264	2247	2229	3	6	9	12	14
31	0.2212	2195	2178	2161	2144	2127	2110	2093	2076	2059	3	6	9	11	14
32	0.2042	2025	2008	1992	1975	1958	1941	1925	1908	1891	3	6	9	11	14
33	0.1875	1858	1842	1825	1809	1792	1776	1759	1743	1726	3	5	8	11	14
34	0.1710	1694	1677	1661	1645	1629	1612	1596	1580	1564	3	5	8	11	14
35	0.1548	1532	1516	1499	1483	1467	1451	1435	1419	1403	3	5	8	11	13
36	0.1387	1371	1356	1340	1324	1308	1292	1276	1260	1245	3	5	8	11	13
37	0.1229	1213	1197	1182	1166	1150	1135	1119	1103	1088	3	5	8	10	13
38	0.1072	1056	1041	1025	1010	0994	0978	0963	0947	0932	3	5	8	10	13
39	0.0916	901	885	870	854	839	824	808	0793	0777	3	5	8	10	13
40	0.0762	7446	731	716	700	685	670	654	639	624	3	5	8	10	13
41	0.0608	593	578	562	547	532	517	501	486	471	3	5	8	10	13
42	0.0456	440	425	410	395	379	364	349	334	319	3	5	8	10	13
43	0.0303	288	273	258	243	228	0212	0197	0182	0167	3	5	8	10	13
44	0.0152	0136	0121	0106	0091	0076	0061	0045	0030	0015	3	5	8	10	13
	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'

The black type indicates that the integer changes.

LOG. COTANGENTS

SUBTRACT

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
45°	0.0000	9985	9970	9955	9939	9924	9909	9777	9752	9864	3	5	8	10	13
46	1.9848	9833	9818	9803	9788	9772	9742	9727	9712	9864	3	5	8	10	13
47	1.9697	9681	9666	9651	9636	9621	9605	9590	9575	9560	3	5	8	10	13
48	1.9544	9529	9514	9499	9483	9468	9453	9438	9422	9407	3	5	8	10	13
49	1.9392	9376	9361	9346	9330	9315	9300	9284	9269	9254	3	5	8	10	13
50	1.9238	9223	9207	9192	9176	9161	9146	9130	9115	9099	3	5	8	10	13
51	1.9084	9068	9053	9037	9022	9006	8990	8975	8959	8944	3	5	8	10	13
52	1.8928	8912	8897	8881	8865	8850	8834	8818	8803	8787	3	5	8	10	13
53	1.8771	8755	8740	8724	8708	8692	8676	8660	8644	8629	3	5	8	10	13
54	1.8613	8597	8581	8565	8549	8533	8517	8501	8484	8468	3	5	8	11	13
55	1.8452	8436	8420	8404	8388	8371	8355	8339	8323	8306	3	5	8	11	14
56	1.8290	8274	8257	8241	8224	8208	8191	8175	8158	8142	3	5	8	11	14
57	1.8125	8109	8092	8075	8059	8042	8025	8008	7992	7975	3	6	8	11	14
58	1.7958	7941	7924	7907	7890	7873	7856	7839	7822	7805	3	6	9	11	14
59	1.7788	7771	7753	7736	7719	7701	7684	7667	7649	7632	3	6	9	12	14
60	1.7614	7597	7579	7562	7544	7526	7509	7491	7473	7455	3	6	9	12	15
61	1.7438	7420	7402	7384	7366	7348	7330	7311	7293	7275	3	6	9	12	15
62	1.7257	7238	7220	7202	7183	7165	7146	7128	7109	7090	3	6	9	12	15
63	1.7072	7053	7034	7015	6996	6977	6958	6939	6920	6901	3	6	9	13	16
64	1.6882	6863	6843	6824	6804	6785	6765	6746	6726	6706	3	6	9	10	13
65	1.6687	6667	6647	6627	6607	6587	6567	6547	6527	6506	3	7	10	13	17
66	1.6486	6465	6445	6424	6404	6383	6362	6341	6321	6300	3	7	10	13	17

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
67	1.6279	6257	6236	6215	6194	6172	6151	6129	6108	6086	4	7	11	14	18
68	1.6064	6042	6020	5998	5976	5954	5932	5909	5887	5864	4	7	11	15	19
69	1.5842	5819	5796	5773	5750	5727	5704	5681	5658	5634	4	8	12	15	19
70	1.5611	5587	5563	5539	5516	5491	5467	5443	5419	5394	4	8	12	16	20
71	1.5370	5345	5320	5295	5270	5245	5220	5195	5169	5143	4	8	13	17	21
72	1.5118	5092	5066	5040	5014	4987	4961	4934	4907	4880	4	9	13	18	22
73	1.4833	4826	4799	4771	4744	4716	4688	4660	4632	4603	5	9	14	19	23
74	1.4575	4517	4488	4459	4430	4400	4371	4341	4311	4281	5	10	15	20	25
75	1.4281	4250	4220	4189	4158	4127	4095	4064	4032	4000	5	10	16	21	26
76	1.3968	3935	3903	3870	3837	3804	3770	3736	3702	3668	6	11	17	22	28
77	1.3634	3599	3564	3529	3493	3458	3422	3385	3349	3312	6	12	18	24	30
78	1.3275	3237	3200	3162	3123	3085	3046	3006	2967	2927	6	13	19	26	32
79	1.2987	2846	2805	2764	2722	2680	2637	2594	2551	2507	7	14	21	28	35
80	1.2463	2419	2374	2328	2282	2236	2189	2142	2094	2046	8	16	23	31	39
81	1.1997	1948	1898	1843	1797	1745	1693	1640	1587	1533	9	17	26	35	43
82	1.1478	1423	1367	1310	1252	1194	1135	1076	1015	954	10	20	29	39	49
83	1.0891	0828	0764	0699	0633	0567	0499	0430	0360	0289	11	22	34	45	56
84	1.0216	0143	0068	9992	9915	9836	9756	9674	9591	9506	13	26	40	53	66
85	5.9420	9331	9241	9150	9056	8960	8862	8762	8659	8554	16	32	48	65	81
86	5.8446	8336	8223	8107	7988	7865	7739	7609	7475	7337	21	42	63	83	104
87	5.7194	7046	6894	6736	6571	6401	6223	6038	5845	5643	2833	3211	3543	3242	Differences untrustworthy here
88	5.5431	5208	4973	4725	4461	4181	3831	3559	3211	3543	3	4	8	16	31
89	5.242	2145	2.087	2.020	3.941	3.844	3.719	3.5719	3.5443	3.5242	3	4	8	16	31

The black type indicates that the integer changes.

LOG. SECANTS

	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°
0°	0.00000	0.00000	0.00000	0.00001	0.00001	0.00000	0.00001	0.00002	0.00000	0.00001	0.0001	0.0002	0.0003	0.0004	0.0005
1	0.00001	0.00001	0.00003	0.00003	0.00004	0.00004	0.00004	0.00004	0.00004	0.00004	0.00005	0.00005	0.00006	0.00006	0.00006
2	0.00003	0.00003	0.00006	0.00006	0.00007	0.00007	0.00008	0.00008	0.00009	0.00009	0.00010	0.00010	0.00010	0.00010	0.00010
3	0.00006	0.00006	0.00011	0.00011	0.00012	0.00012	0.00013	0.00013	0.00014	0.00015	0.00015	0.00016	0.00016	0.00016	0.00016
4	0.00011	0.00011	0.00017	0.00017	0.00018	0.00019	0.00019	0.00020	0.00021	0.00022	0.00023	0.00023	0.00023	0.00023	0.00023
5	0.00017	0.00017	0.00024	0.00024	0.00025	0.00025	0.00026	0.00027	0.00028	0.00029	0.00030	0.00031	0.00032	0.00032	0.00032
6	0.00024	0.00024	0.00032	0.00032	0.00033	0.00034	0.00035	0.00036	0.00037	0.00038	0.00039	0.00040	0.00041	0.00041	0.00041
7	0.00032	0.00032	0.00042	0.00042	0.00044	0.00044	0.00045	0.00046	0.00047	0.00048	0.00049	0.00050	0.00051	0.00053	0.00053
8	0.00042	0.00042	0.00054	0.00054	0.00055	0.00056	0.00057	0.00057	0.00059	0.00060	0.00061	0.00063	0.00064	0.00065	0.00065
9	0.00054	0.00054	0.00066	0.00066	0.00068	0.00068	0.00069	0.00071	0.00072	0.00073	0.00075	0.00076	0.00078	0.00079	0.00079
10	0.00066	0.00066	0.00081	0.00081	0.00082	0.00082	0.00084	0.00085	0.00087	0.00088	0.00090	0.00091	0.00093	0.00094	0.00094
11	0.00081	0.00081	0.00096	0.00096	0.00098	0.00098	0.00099	0.00101	0.00103	0.00104	0.00106	0.00108	0.00110	0.00111	0.00111
12	0.00096	0.00096	0.0113	0.0113	0.0115	0.0115	0.0116	0.0118	0.0120	0.0122	0.0124	0.0125	0.0127	0.0129	0.0129
13	0.0113	0.0113	0.0131	0.0131	0.0135	0.0135	0.0137	0.0139	0.0141	0.0143	0.0145	0.0147	0.0149	0.0149	0.0149
14	0.0131	0.0131	0.0151	0.0151	0.0153	0.0153	0.0155	0.0157	0.0159	0.0161	0.0163	0.0165	0.0167	0.0169	0.0169
15	0.0151	0.0151	0.0172	0.0172	0.0174	0.0174	0.0176	0.0178	0.0180	0.0183	0.0185	0.0187	0.0189	0.0192	0.0192
16	0.0172	0.0172	0.0194	0.0194	0.0196	0.0196	0.0199	0.0201	0.0203	0.0206	0.0208	0.0211	0.0213	0.0215	0.0215
17	0.0194	0.0194	0.0218	0.0218	0.0220	0.0220	0.0223	0.0225	0.0228	0.0230	0.0233	0.0236	0.0238	0.0241	0.0241
18	0.0218	0.0218	0.0243	0.0243	0.0246	0.0246	0.0249	0.0251	0.0254	0.0257	0.0259	0.0262	0.0265	0.0267	0.0267
19	0.0243	0.0243	0.0270	0.0270	0.0273	0.0273	0.0276	0.0278	0.0281	0.0284	0.0287	0.0290	0.0293	0.0296	0.0296
20	0.0270	0.0270	0.0298	0.0298	0.0301	0.0301	0.0304	0.0307	0.0310	0.0313	0.0316	0.0319	0.0322	0.0325	0.0325
21	0.0298	0.0298													

	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°
22	0.0328	0.0331	0.0363	0.0396	0.0399	0.0403	0.0406	0.0410	0.0413	0.0417	0.0376	0.0379	0.0383	0.0386	0.0389
23	0.0360	0.0393	0.0404	0.0407	0.0410	0.0413	0.0416	0.0419	0.0422	0.0424	0.0417	0.0420	0.0424	0.0424	0.0424
24	0.0393	0.0404	0.0431	0.0434	0.0438	0.0442	0.0445	0.0449	0.0452	0.0456	0.0452	0.0456	0.0460	0.0460	0.0460
25	0.0427	0.0467	0.0471	0.0475	0.0478	0.0482	0.0486	0.0486	0.0490	0.0494	0.0494	0.0497	0.0497	0.0497	0.0497
26	0.0463	0.0505	0.0509	0.0513	0.0517	0.0521	0.0525	0.0529	0.0533	0.0533	0.0537	0.0537	0.0537	0.0537	0.0537
27	0.0501	0.0541	0.0545	0.0549	0.0553	0.0557	0.0561	0.0565	0.0569	0.0573	0.0573	0.0578	0.0578	0.0578	0.0578
28	0.0541	0.0582	0.0590	0.0594	0.0599	0.0603	0.0607	0.0612	0.0616	0.0620	0.0620	0.0620	0.0620	0.0620	0.0620
29	0.0625	0.0629	0.0633	0.0638	0.0642	0.0647	0.0651	0.0656	0.0660	0.0665	0.0665	0.0665	0.0665	0.0665	0.0665
30	0.0669	0.0674	0.0678	0.0683	0.0688	0.0692	0.0697	0.0702	0.0706	0.0711	0.0711	0.0711	0.0711	0.0711	0.0711
31	0.0669	0.0716	0.0721	0.0725	0.0730	0.0735	0.0740	0.0745	0.0749	0.0754	0.0754	0.0759	0.0759	0.0759	0.0759
32	0.0716	0.0764	0.0769	0.0774	0.0779	0.0784	0.0789	0.0794	0.0799	0.0804	0.0804	0.0809	0.0809	0.0809	0.0809
33	0.0764	0.0814	0.0819	0.0825	0.0830	0.0835	0.0840	0.0845	0.0851	0.0856	0.0856	0.0861	0.0861	0.0861	0.0861
34	0.0814	0.0866	0.0872	0.0877	0.0882	0.0888	0.0893	0.0899	0.0904	0.0909	0.0909	0.0915	0.0915	0.0915	0.0915
35	0.0866	0.0920	0.0926	0.0931	0.0937	0.0943	0.0948	0.0954	0.0959	0.0965	0.0965	0.0971	0.0971	0.0971	0.0971
36	0.0920	0.0977	0.0982	0.0988	0.0994	0.1000	0.1005	0.1011	0.1017	0.1023	0.1023	0.1029	0.1029	0.1029	0.1029
37	0.0977	0.1035	0.1041	0.1047	0.1053	0.1059	0.1065	0.1071	0.1077	0.1083	0.1083	0.1089	0.1089	0.1089	0.1089
38	0.1035	0.1095	0.1101	0.1107	0.1113	0.1120	0.1126	0.1132	0.1138	0.1145	0.1145	0.1151	0.1151	0.1151	0.1151
39	0.1095	0.1222	0.1229	0.1235	0.1242	0.1249	0.1255	0.1262	0.1269	0.1276	0.1276	0.1282	0.1282	0.1282	0.1282
40	0.1157	0.1164	0.1170	0.1177	0.1183	0.1190	0.1196	0.1203	0.1209	0.1216	0.1216	0.1226	0.1226	0.1226	0.1226
41	0.1222	0.1289	0.1303	0.1310	0.1317	0.1324	0.1331	0.1338	0.1345	0.1352	0.1352	0.1362	0.1362	0.1362	0.1362
42	0.1289	0.1339	0.1366	0.1373	0.1380	0.1387	0.1394	0.1402	0.1409	0.1416	0.1416	0.1423	0.1423	0.1423	0.1423
43	0.1339	0.1431	0.1445	0.1445	0.1453	0.1460	0.1468	0.1475	0.1475	0.1483	0.1483	0.1490	0.1490	0.1490	0.1490
44	0.1431														
	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°

LOG. SECANTS

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
45°	1513	1520	1528	1536	1543	1551	1559	1567	1574	1	3	4	5	6	7
46	1582	1590	1598	1606	1614	1622	1630	1638	1646	1654	1	3	4	5	6
47	1662	1670	1678	1687	1695	1703	1711	1720	1728	1736	1	3	4	5	7
48	1745	1753	1762	1770	1779	1787	1796	1805	1813	1821	1	3	4	6	7
49	1831	1839	1848	1857	1866	1875	1883	1892	1901	1910	1	3	4	6	7
50	1919	1928	1937	1947	1956	1965	1974	1983	1993	2002	2	3	5	6	8
51	0-2011	2021	2030	2040	2049	2059	2068	2078	2087	2097	2	3	5	6	8
52	0-2107	2116	2126	2136	2146	2156	2165	2175	2185	2195	2	3	5	7	8
53	0-2205	2215	2226	2236	2246	2256	2266	2277	2287	2297	2	3	5	7	9
54	0-2308	2318	2329	2339	2350	2360	2371	2382	2393	2403	2	4	5	7	9
55	0-2414	2425	2436	2447	2458	2469	2480	2491	2502	2513	2	4	5	7	9
56	0-2524	2536	2547	2558	2570	2581	2593	2604	2616	2627	2	4	6	8	10
57	0-2639	2651	2662	2674	2686	2698	2710	2722	2734	2746	2	4	6	8	10
58	0-2758	2770	2782	2795	2807	2819	2832	2844	2856	2869	2	4	6	8	10
59	0-2882	2894	2907	2920	2932	2945	2958	2971	2984	2997	2	4	6	9	11
60	0-3010	3023	3037	3050	3063	3077	3090	3104	3117	3131	2	4	7	9	11
61	0-3144	3158	3172	3186	3199	3213	3227	3241	3256	3270	2	5	7	9	12
62	0-3284	3298	3313	3327	3341	3356	3371	3385	3400	3415	2	5	7	10	12
63	0-3430	3444	3459	3474	3490	3505	3520	3535	3551	3566	3	5	8	10	13
64	0-3582	3597	3613	3629	3644	3660	3676	3692	3708	3724	3	5	8	11	13
65	0-3741	3757	3773	3790	3806	3823	3839	3856	3873	3890	3	6	8	11	14
66	0-3907	3924	3941	3958	3976	3993	4010	4028	4046	4063	3	6	9	12	15

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
67	0-4081	4099	4117	4135	4153	4172	4190	4208	4227	4246	3	6	9	12	15
68	0-4264	4283	4302	4321	4340	4359	4379	4398	4417	4437	3	6	10	13	16
69	0-4457	4477	4496	4516	4537	4557	4577	4598	4618	4639	3	7	10	14	17
70	0-4659	4680	4701	4722	4744	4765	4787	4808	4830	4852	4	7	11	14	18
71	0-4874	4896	4918	4940	4963	4985	5008	5031	5054	5077	4	8	11	15	19
72	0-5100	5124	5147	5171	5195	5219	5243	5267	5291	5316	4	8	12	16	20
73	0-5341	5366	5391	5416	5441	5467	5492	5518	5544	5570	4	9	13	17	21
74	0-5597	5623	5650	5677	5704	5731	5758	5786	5814	5842	5	9	14	18	23
75	0-5870	5898	5927	5956	5985	6014	6043	6073	6103	6133	5	10	15	20	24
76	0-6163	6194	6225	6255	6287	6318	6350	6382	6414	6446	5	11	16	21	26
77	0-6479	6512	6545	6579	6613	6647	6681	6716	6750	6786	6	11	17	23	28
78	0-6821	6857	6893	6930	6966	7003	7041	7079	7117	7155	6	12	19	25	31
79	0-7194	7233	7273	7313	7353	7394	7435	7476	7518	7561	7	14	20	27	34
80	0-7603	7647	7690	7734	7779	7824	7869	7915	7962	8009	8	15	23	30	38
81	0-8057	8105	8153	8203	8253	8303	8354	8406	8458	8511	8	17	25	34	42
82	0-8564	8619	8674	8729	8786	8843	8901	8960	9019	9080	10	19	29	38	48
83	0-9141	9203	9266	9330	9395	9461	9528	9597	9666	9736	11	22	33	44	55
84	0-9808	9880	9954	0-0030	0-0106	0-0184	0-0264	0-0345	0-0427	0-0511	13	26	39	53	66
85	1-0597	0-685	0-774	0-865	0-958	1-054	1-151	1-251	1-353	1-457	16	32	48	64	81
86	1-1564	1-674	1-787	1-902	2-021	2-143	2-269	2-398	2-532	2-670	21	41	62	83	103
87	1-2812	2-959	3-111	3-269	3-433	3-603	3-780	3-965	4-158	4-4360	4-7168				
88	1-4572	4-794	5-029	5-277	5-541	5-821	6-162	6-6442	7-679	8-0457	2-758				
89	1-7581	1-804	1-855	1-980	2-059	2-156	2-281								
	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'

The black type indicates that the integer changes.

Differences
untrustworthy
here

LOG. COSECANTS

SUBTRACT

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1°	2°	3°	4°	5°
0°	+ .00	2758	2457	2281	2156	2059	1980	1913	1855	1804					
1	1.7581	7168	6790	6442	6120	5821	5541	5277	5029	4794					
2	1.4572	4360	4158	3965	3780	3603	3433	3269	3111	2959					
3	1.2812	2670	2532	2398	2269	2143	2021	1902	1787	1674	21	41	62	83	103
4	1.1564	1457	1353	1251	1151	1054	0958	0865	0774	0685	16	32	48	64	81
5	1.0597	0511	0427	0345	0264	0184	0106	0030	9954	9880	13	26	39	53	66
6	0.9808	9736	9666	9597	9528	9461	9395	9330	9266	9203	11	22	33	44	55
7	0.9141	9080	9019	8960	8901	8843	8786	8729	8674	8619	10	19	29	38	48
8	0.8364	8511	8458	8406	8354	8303	8253	8203	8153	8105	8	17	25	34	42
9	0.8057	8009	7962	7915	7869	7824	7779	7734	7690	7647	8	15	23	30	38
10	0.7603	7561	7518	7476	7435	7394	7353	7313	7273	7233	7	14	20	27	34
11	0.7194	7155	7117	7079	7041	7003	6966	6930	6893	6857	6	12	19	25	31
12	0.6821	6786	6750	6716	6681	6647	6613	6579	6545	6512	6	11	17	23	28
13	0.6479	6446	6414	6382	6350	6318	6287	6255	6225	6194	5	11	16	21	26
14	0.6163	6133	6103	6073	6043	6014	5985	5956	5927	5898	5	10	15	20	24
15	0.5870	5842	5814	5786	5758	5731	5704	5677	5650	5623	5	9	14	18	23
16	0.5597	5570	5544	5518	5492	5467	5441	5416	5391	5366	4	9	13	17	21
17	0.5341	5316	5291	5267	5243	5219	5195	5171	5147	5124	4	8	12	16	20
18	0.5100	5077	5054	5031	5008	4985	4963	4940	4918	4896	4	8	11	15	19
19	0.4874	4832	4830	4808	4787	4765	4744	4722	4701	4680	4	7	11	14	18
20	0.4659	4639	4618	4598	4577	4557	4537	4516	4496	4477	3	7	10	14	17
21	0.4457	4437	4417	4398	4379	4359	4340	4321	4302	4283	3	6	10	13	16
22	0.4264	4246	4227	4208	4190	4172	4153	4135	4117	4099	3	6	9	12	15
23	0.4081	4063	4046	4028	4010	3993	3976	3958	3941	3924	3	6	9	12	15
24	0.3907	3890	3873	3856	3839	3823	3806	3790	3773	3757	3	6	8	11	14
25	0.3741	3724	3708	3692	3676	3660	3644	3629	3613	3597	3	5	8	11	15
26	0.3592	3566	3551	3535	3520	3505	3490	3474	3459	3444	3	5	8	10	13
27	0.3430	3415	3400	3385	3371	3356	3341	3327	3313	3298	2	5	7	10	12
28	0.3284	3270	3256	3241	3227	3213	3199	3186	3172	3158	2	5	7	9	12
29	0.3144	3131	3117	3104	3090	3077	3063	3050	3037	3023	2	4	7	9	11
30	0.3010	2997	2984	2971	2958	2945	2932	2919	2907	2894	2	4	6	9	11
31	0.2882	2869	2856	2844	2832	2819	2807	2795	2782	2770	2	4	6	8	10
32	0.2758	2746	2734	2722	2710	2698	2686	2674	2662	2651	2	4	6	8	10
33	0.2639	2627	2616	2604	2593	2581	2570	2558	2547	2536	2	4	6	8	10
34	0.2524	2513	2502	2491	2480	2469	2458	2447	2436	2425	2	4	6	7	9
35	0.2414	2403	2393	2382	2371	2360	2350	2339	2329	2318	2	4	5	7	9
36	0.2308	2297	2287	2277	2266	2256	2246	2236	2226	2215	2	3	5	7	9
37	0.2205	2195	2185	2175	2165	2156	2146	2136	2126	2116	2	3	5	6	8
38	0.2107	2097	2087	2078	2068	2059	2049	2040	2037	2021	2	3	5	6	8
39	0.2011	2002	1993	1983	1974	1965	1956	1947	1937	1928	2	3	5	6	8
40	0.1919	1910	1901	1892	1883	1875	1866	1857	1848	1839	1	3	4	6	7
41	0.1831	1822	1813	1805	1796	1787	1779	1770	1762	1753	1	3	4	6	7
42	0.1745	1736	1728	1720	1711	1703	1695	1687	1678	1670	1	3	4	6	7
43	0.1662	1654	1646	1638	1630	1622	1614	1606	1598	1590	1	3	4	5	6
44	0.1582	1574	1567	1559	1551	1543	1536	1528	1520	1513	1	3	4	5	6
	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1°	2°	3°	4°	5°

The black type indicates that the integer changes.

LOG. COSECANTS

SUBTRACT

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
45°	0-1505	1498	1490	1483	1475	1468	1460	1453	1445	1438	1	2	4	5	6
46	0-1431	1423	1416	1409	1402	1394	1387	1380	1373	1366	1	2	4	5	6
47	0-1359	1352	1345	1338	1331	1324	1317	1310	1303	1296	1	2	3	5	6
48	0-1289	1282	1276	1269	1262	1255	1249	1242	1235	1229	1	2	3	4	6
49	0-1222	1216	1209	1203	1196	1190	1183	1177	1170	1164	1	2	3	4	5
50	0-1157	1151	1145	1138	1132	1126	1120	1113	1107	1101	1	2	3	4	5
51	0-1095	1089	1083	1077	1071	1065	1059	1053	1047	1041	1	2	3	4	5
52	0-1035	1029	1023	1017	1011	1005	1000	994	988	982	1	2	3	4	5
53	0-0977	971	965	959	954	948	943	937	931	926	1	2	3	4	5
54	0-0920	915	909	904	899	893	888	882	877	872	1	2	3	4	5
55	0-0856	861	856	851	845	840	835	830	825	819	1	2	3	4	5
56	0-0814	809	804	799	794	789	784	779	774	769	1	2	3	4	5
57	0-0754	759	754	749	745	740	735	730	725	721	1	2	3	4	5
58	0-0716	711	706	702	697	692	688	683	678	674	1	2	3	4	5
59	0-0669	665	660	655	651	647	642	638	633	629	1	2	3	4	5
60	0-0625	620	616	612	607	603	599	594	590	586	1	2	3	4	5
61	0-0582	578	573	569	565	561	557	553	549	545	1	2	3	3	3
62	0-0541	537	533	529	525	521	517	513	509	505	1	2	3	3	3
63	0-0501	497	494	490	486	482	478	475	471	467	1	2	3	3	3
64	0-0463	460	456	452	449	445	442	438	434	431	1	2	2	2	3
65	0-0427	424	420	417	413	410	406	403	399	396	1	1	2	2	3
66	0-0393	389	386	383	379	376	373	369	366	363	1	1	2	2	3

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
67	0-0360	357	353	350	347	344	341	338	334	331	1	2	2	2	2
68	0-0328	325	322	319	316	313	310	307	304	301	0	1	1	1	1
69	0-0298	296	293	290	287	284	281	278	276	273	0	1	1	1	1
70	0-0270	267	265	262	259	257	254	251	249	246	0	1	1	1	1
71	0-0243	241	238	236	233	230	228	225	223	220	0	1	1	1	1
72	0-0218	215	213	211	208	206	203	201	199	196	0	1	1	1	1
73	0-0194	192	189	187	185	183	180	178	176	174	0	1	1	1	1
74	0-0172	169	167	165	163	161	159	157	155	153	0	1	1	1	1
75	0-0151	149	147	145	143	141	139	137	135	133	0	1	1	1	1
76	0-0131	129	127	125	124	122	120	118	116	115	0	1	1	1	1
77	0-0113	111	109	108	106	104	103	101	99	98	0	1	1	1	1
78	0-0096	994	993	991	990	988	987	985	984	982	0	0	1	1	1
79	0-0081	79	78	77	76	75	73	72	71	69	0	0	1	1	1
80	0-0066	665	664	663	661	660	659	657	656	655	0	0	0	0	0
81	0-0054	553	551	550	549	548	547	546	545	544	0	0	0	0	0
82	0-0042	441	440	439	438	437	436	435	434	433	0	0	0	0	0
83	0-0032	332	331	330	329	328	327	326	325	325	0	0	0	0	0
84	0-0024	23	22	22	21	20	19	18	18	17	0	0	0	0	0
85	0-0017	116	115	114	113	112	111	110	109	108	0	0	0	0	0
86	0-0011	110	109	108	107	106	105	104	103	102	0	0	0	0	0
87	0-0006	66	65	65	64	64	63	63	62	62	0	0	0	0	0
88	0-0003	2	2	2	2	2	2	2	2	2	0	0	0	0	0
89	0-0001	1	1	1	1	1	1	1	1	1	0	0	0	0	0
	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'

NATURAL SINES

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1°	2°	3°	4°	5°
0°	0.0000	0.0117	0.0335	0.0552	0.0770	0.0987	0.105	0.122	0.140	0.157	3	6	9	12	15
1	·0175	0.0192	0.0227	0.0244	0.0262	0.0279	0.0297	0.0314	0.0332	0.0352	3	6	9	12	15
2	·0349	0.0366	0.0384	0.0401	0.0419	0.0436	0.0454	0.0471	0.0488	0.0506	3	6	9	12	15
3	·0523	0.0541	0.0558	0.0576	0.0593	0.0610	0.0628	0.0645	0.0663	0.0680	3	6	9	12	15
4	·0698	0.0715	0.0732	0.0750	0.0767	0.0785	0.0802	0.0819	0.0837	0.0854	3	6	9	12	14
5	·0872	0.0889	0.0906	0.0924	0.0941	0.0958	0.0976	0.0993	0.1011	0.1028	3	6	9	12	14
6	·1045	0.1063	0.1080	0.1097	0.1115	0.1132	0.1149	0.1167	0.1184	0.1201	3	6	9	12	14
7	·1219	0.1236	0.1253	0.1271	0.1288	0.1305	0.1323	0.1340	0.1357	0.1374	3	6	9	12	14
8	·1392	0.1409	0.1426	0.1444	0.1461	0.1478	0.1495	0.1513	0.1530	0.1547	3	6	9	12	14
9	·1564	0.1582	0.1599	0.1616	0.1633	0.1650	0.1668	0.1685	0.1702	0.1719	3	6	9	11	14
10	·1736	0.1754	0.1771	0.1788	0.1805	0.1822	0.1840	0.1857	0.1874	0.1891	3	6	9	11	14
11	·1908	0.1925	0.1942	0.1959	0.1977	0.1994	0.2011	0.2028	0.2045	0.2062	3	6	9	11	14
12	·2079	0.2096	0.2113	0.2130	0.2147	0.2164	0.2181	0.2198	0.2215	0.2233	3	6	9	11	14
13	·2250	0.2267	0.2284	0.2300	0.2317	0.2334	0.2351	0.2368	0.2385	0.2402	3	6	8	11	14
14	·2419	0.2436	0.2453	0.2470	0.2487	0.2504	0.2521	0.2538	0.2554	0.2571	3	6	8	11	14
15	·2588	0.2605	0.2622	0.2639	0.2656	0.2672	0.2689	0.2706	0.2723	0.2740	3	6	8	11	14
16	·2756	0.2773	0.2790	0.2807	0.2823	0.2840	0.2857	0.2874	0.2890	0.2907	3	6	8	11	14
17	·2924	0.2940	0.2957	0.2974	0.2990	0.3007	0.3024	0.3040	0.3057	0.3074	3	6	8	11	14
18	·3090	0.3107	0.3123	0.3140	0.3156	0.3173	0.3190	0.3206	0.3223	0.3239	3	6	8	11	14
19	·3256	0.3272	0.3289	0.3305	0.3322	0.3338	0.3355	0.3371	0.3387	0.3404	3	5	8	11	14
20	·3420	0.3437	0.3453	0.3469	0.3486	0.3502	0.3518	0.3535	0.3551	0.3567	3	5	8	11	14
21	·3584	0.3600	0.3616	0.3633	0.3649	0.3665	0.3681	0.3697	0.3714	0.3730	3	5	8	11	14

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1°	2°	3°	4°	5°
0°	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
1	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
2	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
3	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
4	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
5	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
6	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
7	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
8	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
9	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
10	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
11	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
12	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
13	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
14	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
15	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
16	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
17	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
18	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
19	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
20	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11
21	13	11	11	11	11	11	11	11	11	11	13	11	11	11	11

NATURAL SINES

	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°
45°	.7071	.7093	.7108	.7120	.7133	.7145	.7157	.7169	.7181	.7193	.7202	.7209	.7216	.7223	.7230
46	.7193	.7206	.7218	.7230	.7242	.7254	.7266	.7278	.7290	.7302	.7311	.7323	.7330	.7337	.7349
47	.7314	.7325	.7337	.7349	.7361	.7373	.7385	.7396	.7408	.7420	.7431	.7442	.7450	.7458	.7466
48	.7431	.7443	.7455	.7466	.7478	.7490	.7501	.7513	.7524	.7536	.7547	.7558	.7569	.7579	.7581
49	.7547	.7559	.7570	.7581	.7593	.7604	.7615	.7627	.7638	.7649	.7660	.7671	.7683	.7694	.7705
50	.7660	.7672	.7683	.7694	.7705	.7716	.7727	.7738	.7749	.7760	.7771	.7782	.7793	.7804	.7815
51	.7771	.7782	.7793	.7804	.7912	.7923	.7934	.7944	.7955	.7965	.7976	.7987	.7998	.8009	.8018
52	.7880	.7891	.7902	.7912	.7923	.7934	.7944	.7955	.7965	.7976	.7987	.7998	.8009	.8020	.8028
53	.7986	.7997	.8007	.8018	.8028	.8039	.8049	.8059	.8070	.8080	.8090	.8101	.8111	.8121	.8131
54	.8090	.8100	.8111	.8121	.8131	.8141	.8151	.8161	.8171	.8181	.8191	.8202	.8211	.8221	.8231
55	.8192	.8202	.8211	.8221	.8231	.8241	.8251	.8261	.8271	.8281	.8291	.8300	.8310	.8320	.8330
56	.8290	.8300	.8310	.8320	.8330	.8339	.8348	.8358	.8368	.8377	.8386	.8395	.8404	.8413	.8422
57	.8387	.8396	.8406	.8415	.8425	.8434	.8443	.8453	.8462	.8471	.8480	.8489	.8498	.8507	.8516
58	.8480	.8490	.8499	.8508	.8517	.8526	.8536	.8545	.8554	.8563	.8572	.8581	.8590	.8599	.8607
59	.8572	.8581	.8590	.8599	.8607	.8616	.8625	.8634	.8643	.8652	.8661	.8670	.8678	.8686	.8695
60	.8660	.8669	.8678	.8686	.8695	.8704	.8712	.8721	.8729	.8738	.8747	.8756	.8765	.8774	.8783
61	.8745	.8753	.8763	.8771	.8780	.8788	.8796	.8805	.8813	.8821	.8830	.8839	.8848	.8857	.8866
62	.8829	.8838	.8846	.8854	.8862	.8870	.8878	.8886	.8894	.8902	.8911	.8920	.8929	.8938	.8947
63	.8918	.8926	.8934	.8942	.8950	.8958	.8965	.8973	.8980	.8988	.9006	.9015	.9024	.9033	.9042
64	.8988	.8996	.9003	.9011	.9018	.9026	.9033	.9041	.9048	.9056	.9065	.9074	.9083	.9092	.9100
65	.9063	.9070	.9078	.9085	.9092	.9100	.9107	.9114	.9121	.9128	.9137	.9146	.9155	.9164	.9171
66	.9135	.9143	.9150	.9157	.9164	.9171	.9178	.9184	.9191	.9198	.9205	.9212	.9219	.9225	.9232

67	.9272	.9278	.9285	.9291	.9298	.9304	.9311	.9317	.9323	.9329	.9330	.9335	.9339	.9341	.9345	.9350
68	.9336	.9342	.9348	.9354	.9361	.9367	.9373	.9379	.9385	.9391	.9391	.9391	.9391	.9391	.9391	.9391
69	.9397	.9403	.9409	.9415	.9421	.9426	.9432	.9438	.9444	.9449	.9449	.9449	.9449	.9449	.9449	.9449
70	.9445	.9461	.9466	.9472	.9478	.9483	.9489	.9494	.9500	.9505	.9505	.9505	.9505	.9505	.9505	.9505
72	.9511	.9516	.9521	.9527	.9532	.9537	.9542	.9548	.9553	.9558	.9563	.9568	.9573	.9578	.9583	.9588
73	.9563	.9573	.9578	.9583	.9588	.9593	.9598	.9603	.9608	.9613	.9618	.9623	.9627	.9632	.9636	.9641
74	.9613	.9617	.9622	.9627	.9632	.9636	.9641	.9646	.9650	.9655	.9661	.9666	.9671	.9676	.9681	.9686
75	.9659	.9664	.9668	.9673	.9677	.9681	.9686	.9691	.9694	.9699	.9704	.9709	.9714	.9719	.9724	.9728
76	.9703	.9707	.9711	.9715	.9720	.9724	.9728	.9732	.9736	.9740	.9744	.9748	.9753	.9758	.9763	.9767
77	.9744	.9748	.9751	.9755	.9759	.9763	.9767	.9770	.9774	.9778	.9782	.9786	.9790	.9794	.9798	.9802
78	.9781	.9785	.9789	.9792	.9796	.9799	.9803	.9806	.9810	.9813	.9817	.9821	.9825	.9829	.9833	.9837
79	.9816	.9820	.9823	.9826	.9829	.9833	.9836	.9839	.9842	.9845	.9848	.9852	.9856	.9860	.9864	.9868
80	.9848	.9851	.9854	.9857	.9860	.9863	.9866	.9869	.9871	.9874	.9874	.9878	.9881	.9884	.9887	.9890
81	.9877	.9880	.9882	.9885	.9888	.9890	.9893	.9895	.9898	.9900	.9900	.9904	.9907	.9910	.9913	.9916
82	.9903	.9905	.9907	.9910	.9912	.9914	.9917	.9919	.9921	.9923	.9923	.9926	.9928	.9930	.9932	.9934
83	.9925	.9928	.9930	.9932	.9934	.9936	.9938	.9940	.9942	.9944	.9944	.9947	.9949	.9951	.9953	.9955
84	.9945	.9947	.9949	.9951	.9952	.9954	.9956	.9957	.9959	.9960	.9960	.9963	.9965	.9967	.9969	.9971
85	.9962	.9963	.9965	.9966	.9968	.9969	.9971	.9972	.9973	.9974	.9974	.9977	.9978	.9979	.9980	.9981
86	.9976	.9977	.9978	.9979	.9980	.9981	.9982	.9983	.9984	.9985	.9985	.9986	.9987	.9988	.9989	.9990
87	.9986	.9987	.9988	.9989	.9990	.9991	.9992	.9993	.9994	.9995	.9995	.9996	.9997	.9998	.9999	.9999
88	.9994	.9995	.9996	.9997	.9998	.9999	.9999	.9999	.9999	.9999	.9999	.9999	.9999	.9999	.9999	.9999
89	.9998															
	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°	

NATURAL COSINES

SUBTRACT

	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°
0°	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
1	.9998	.9998	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997	.9997
2	.9994	.9993	.9993	.9984	.9983	.9982	.9981	.9980	.9979	.9978	.9977	.9977	.9977	.9977	.9977
3	.9986	.9985	.9974	.9973	.9972	.9971	.9969	.9968	.9966	.9965	.9965	.9965	.9965	.9965	.9965
4	.9976	.9962	.9960	.9959	.9957	.9956	.9954	.9952	.9951	.9949	.9947	.9947	.9947	.9947	.9947
5	.9945	.9943	.9942	.9940	.9938	.9936	.9934	.9932	.9930	.9928	.9928	.9928	.9928	.9928	.9928
6	.9925	.9923	.9921	.9919	.9917	.9914	.9912	.9910	.9907	.9905	.9905	.9905	.9905	.9905	.9905
7	.9903	.9898	.9895	.9893	.9890	.9888	.9885	.9882	.9880	.9880	.9880	.9880	.9880	.9880	.9880
8	.9877	.9874	.9871	.9869	.9866	.9863	.9860	.9857	.9854	.9851	.9851	.9851	.9851	.9851	.9851
9	.9848	.9845	.9842	.9839	.9836	.9833	.9830	.9829	.9826	.9823	.9820	.9820	.9820	.9820	.9820
10	.9811	.9810	.9806	.9803	.9799	.9796	.9792	.9789	.9785	.9785	.9785	.9785	.9785	.9785	.9785
11	.9781	.9778	.9774	.9770	.9767	.9763	.9759	.9755	.9751	.9748	.9748	.9748	.9748	.9748	.9748
12	.9744	.9740	.9736	.9732	.9728	.9724	.9720	.9715	.9711	.9707	.9707	.9707	.9707	.9707	.9707
13	.9703	.9699	.9694	.9690	.9686	.9681	.9677	.9673	.9668	.9664	.9664	.9664	.9664	.9664	.9664
14	.9669	.9655	.9650	.9646	.9641	.9636	.9632	.9627	.9622	.9617	.9617	.9617	.9617	.9617	.9617
15	.9631	.9613	.9608	.9603	.9598	.9593	.9588	.9583	.9578	.9573	.9568	.9568	.9568	.9568	.9568
16	.9563	.9558	.9553	.9548	.9542	.9537	.9532	.9527	.9521	.9516	.9516	.9516	.9516	.9516	.9516
17	.9511	.9505	.9500	.9494	.9489	.9483	.9478	.9472	.9466	.9461	.9461	.9461	.9461	.9461	.9461
18	.9455	.9449	.9444	.9438	.9432	.9426	.9421	.9415	.9409	.9403	.9403	.9403	.9403	.9403	.9403
19	.9397	.9391	.9385	.9379	.9373	.9367	.9361	.9354	.9348	.9342	.9342	.9342	.9342	.9342	.9342
20	.9336	.9330	.9323	.9317	.9311	.9304	.9298	.9291	.9285	.9278	.9278	.9278	.9278	.9278	.9278
21															

	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°
22	.9227	.9265	.9259	.9252	.9239	.9232	.9225	.9219	.9212	.9212	.9212	.9212	.9212	.9212	.9212
23	.9205	.9198	.9191	.9184	.9178	.9164	.9157	.9150	.9143	.9143	.9143	.9143	.9143	.9143	.9143
24	.9135	.9128	.9121	.9114	.9107	.9100	.9092	.9085	.9078	.9070	.9070	.9070	.9070	.9070	.9070
25	.9063	.9056	.9048	.9041	.9033	.9026	.9018	.9011	.9003	.8996	.8996	.8996	.8996	.8996	.8996
26	.8988	.8980	.8973	.8965	.8957	.8949	.8942	.8934	.8926	.8918	.8918	.8918	.8918	.8918	.8918
27	.8910	.8902	.8894	.8886	.8878	.8870	.8862	.8854	.8846	.8838	.8838	.8838	.8838	.8838	.8838
28	.8829	.8821	.8813	.8805	.8796	.8788	.8780	.8771	.8763	.8755	.8755	.8755	.8755	.8755	.8755
29	.8746	.8738	.8729	.8721	.8712	.8704	.8695	.8686	.8678	.8669	.8669	.8669	.8669	.8669	.8669
30	.8660	.8652	.8643	.8634	.8625	.8616	.8607	.8599	.8590	.8581	.8581	.8581	.8581	.8581	.8581
31	.8572	.8563	.8554	.8545	.8536	.8526	.8517	.8508	.8499	.8490	.8490	.8490	.8490	.8490	.8490
32	.8480	.8471	.8462	.8453	.8443	.8434	.8425	.8415	.8406	.8396	.8396	.8396	.8396	.8396	.8396
33	.8387	.8377	.8368	.8358	.8348	.8339	.8329	.8320	.8310	.8300	.8300	.8300	.8300	.8300	.8300
34	.8290	.8281	.8271	.8261	.8251	.8241	.8231	.8221	.8211	.8202	.8202	.8202	.8202	.8202	.8202
35	.8192	.8181	.8171	.8161	.8151	.8141	.8131	.8121	.8111	.8100	.8100	.8100	.8100	.8100	.8100
36	.8090	.8080	.8070	.8059	.8049	.8039	.8028	.8018	.8007	.7997	.7997	.7997	.7997	.7997	.7997
37	.7986	.7976	.7965	.7955	.7944	.7934	.7923	.7912	.7902	.7891	.7891	.7891	.7891	.7891	.7891
38	.7880	.7869	.7859	.7848	.7837	.7826	.7815	.7804	.7793	.7782	.7782	.7782	.7782	.7782	.7782
39	.7771	.7760	.7749	.7738	.7727	.7716	.7705	.7694	.7683	.7672	.7672	.7672	.7672	.7672	.7672
40	.7660	.7649	.7638	.7627	.7615	.7604	.7593	.7581	.7570	.7559	.7559	.7559	.7559	.7559	.7559
41	.7547	.7536	.7524	.7513	.7501	.7490	.7478	.7466	.7455	.7443	.7443	.7443	.7443	.7443	.7443
42	.7431	.7420	.7408	.7396	.7385	.7373	.7361	.7349	.7337	.7325	.7325	.7325	.7325	.7325	.7325
43	.7314	.7302	.7290	.7278	.7266	.7254	.7242	.7230	.7218	.7206	.7206	.7206	.7206	.7206	.7206
44	.7193	.7181	.7169	.7157	.7145	.7133	.7120	.7108	.7096	.7083	.7083	.7083	.7083	.7083	.7083
	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°

The black type indicates that the integer changes.

NATURAL COSINES

SUBTRACT

	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°
45°	.7071	7059	7046	7034	7022	7009	6997	6984	6972	6959	2	4	6	8	10
46	.6947	6934	6921	6909	6896	6884	6871	6858	6845	6833	2	4	6	8	11
47	.6820	6807	6794	6782	6769	6756	6743	6730	6717	6704	2	4	6	8	11
48	.6691	6678	6665	6652	6639	6626	6613	6600	6587	6574	2	4	6	9	11
49	.6561	6547	6534	6521	6508	6494	6481	6468	6455	6441	2	4	7	9	11
50	.6428	6414	6401	6388	6374	6361	6347	6334	6320	6307	2	4	7	9	11
51	.6293	6280	6266	6252	6239	6225	6211	6198	6184	6170	2	4	7	9	11
52	.6157	6143	6129	6115	6101	6088	6074	6060	6046	6032	2	5	7	9	11
53	.6018	6004	5990	5976	5962	5948	5934	5920	5906	5892	2	5	7	9	12
54	.5878	5864	5850	5835	5821	5807	5793	5779	5764	5750	2	5	7	9	12
55	.5736	5721	5707	5693	5678	5664	5650	5635	5621	5606	2	5	7	10	12
56	.5592	5577	5563	5548	5534	5519	5505	5490	5476	5461	2	5	7	10	12
57	.5446	5432	5417	5402	5388	5373	5358	5344	5329	5314	2	5	7	10	12
58	.5299	5284	5270	5255	5240	5225	5210	5195	5180	5165	2	5	7	10	12
59	.5150	5135	5120	5105	5090	5075	5060	5045	5030	5015	3	5	8	10	13
60	.5000	4985	4970	4955	4939	4924	4909	4894	4879	4863	3	5	8	10	13
61	.4848	4833	4818	4802	4787	4772	4756	4741	4726	4710	3	5	8	10	13
62	.4695	4679	4664	4648	4633	4617	4602	4586	4571	4555	3	5	8	10	13
63	.4540	4524	4509	4493	4478	4462	4446	4431	4415	4399	3	5	8	10	13
64	.4384	4368	4352	4337	4321	4305	4289	4274	4258	4242	3	5	8	11	13
65	.4226	4210	4195	4179	4163	4147	4131	4115	4099	4083	3	5	8	11	13
66	.4067	4051	4035	4019	4003	3987	3971	3955	3939	3923	3	5	8	11	13

	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°
67	.3907	3891	3875	3859	3843	3827	3811	3795	3778	3762	3	5	8	11	14
68	.3746	3730	3714	3697	3551	3535	3518	3502	3486	3469	3633	3616	3600	3	8
69	.3584	3567	3551	3535	3387	3371	3355	3338	3322	3305	3289	3272	3257	3	8
70	.3420	3404	3387	3371	3206	3190	3173	3156	3140	3123	3107	3090	3	8	11
71	.3256	3239	3223	3057	3040	3024	3007	2990	2974	2957	2940	2923	3	6	11
72	.3090	3074	3057	2907	2890	2874	2857	2840	2823	2807	2773	2750	2723	3	6
73	.2924	2756	2740	2723	2706	2689	2672	2656	2639	2622	2605	2605	2605	3	6
74	.2751	2554	2538	2521	2504	2487	2470	2453	2436	2426	2426	2426	2426	3	6
75	.2588	2402	2385	2368	2351	2334	2317	2300	2284	2267	2267	2267	2267	3	6
76	.2419	2250	2233	2215	2198	2181	2164	2147	2130	2113	2096	2096	2096	3	6
77	.2079	2062	2045	2028	2011	1994	1977	1959	1942	1925	1925	1925	1925	3	6
78	.1908	1891	1874	1857	1840	1822	1805	1788	1771	1754	1754	1754	1754	3	6
79	.1736	1719	1702	1685	1668	1650	1633	1616	1599	1582	1582	1582	1582	3	6
80	.1564	1547	1530	1513	1495	1478	1461	1444	1426	1409	1409	1409	1409	3	6
81	.1392	1374	1357	1340	1323	1305	1288	1271	1253	1236	1236	1236	1236	3	6
82	.1219	1201	1184	1167	1149	1132	1115	1097	1080	1063	1063	1063	1063	3	6
83	.1045	1028	1011	993	976	958	941	924	906	889	889	889	889	3	6
84	.0872	0854	0837	0819	0802	0785	0767	0750	0732	0715	0715	0715	0715	3	6
85	.0698	0680	0663	0645	0628	0610	0593	0576	0558	0541	0541	0541	0541	3	6
86	.0523	0506	0488	0471	0454	0436	0419	0401	0384	0366	0366	0366	0366	3	6
87	.0349	0332	0314	0297	0279	0262	0244	0227	0209	0192	0192	0192	0192	3	6
88	.0175	0157	0140	0122	0105	0087	0070	0052	0035	0017	0017	0017	0017	3	6
89															
	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°

NATURAL TANGENTS

	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°
0°	0.0000	0.017	0.035	0.052	0.070	0.087	0.105	0.122	0.140	0.157	3	6	9	12	15
1	0.0175	0.029	0.044	0.062	0.079	0.097	0.115	0.132	0.150	0.167	3	6	9	12	15
2	0.0349	0.0367	0.0384	0.0402	0.0419	0.0437	0.0454	0.0472	0.0489	0.0507	3	6	9	12	15
3	0.0524	0.0542	0.0559	0.0577	0.0594	0.0612	0.0629	0.0647	0.0664	0.0682	3	6	9	12	15
4	0.0699	0.0717	0.0734	0.0752	0.0769	0.0787	0.0805	0.0822	0.0840	0.0857	3	6	9	12	15
5	0.0875	0.0892	0.0910	0.0928	0.0945	0.0963	0.0981	0.0998	0.1016	0.1033	3	6	9	12	15
6	0.1051	0.1069	0.1086	0.1104	0.1122	0.1139	0.1157	0.1175	0.1192	0.1210	3	6	9	12	15
7	0.1228	0.1246	0.1263	0.1281	0.1299	0.1317	0.1334	0.1352	0.1370	0.1388	3	6	9	12	15
8	0.1405	0.1423	0.1441	0.1459	0.1477	0.1495	0.1512	0.1530	0.1548	0.1566	3	6	9	12	15
9	0.1584	0.1602	0.1620	0.1638	0.1655	0.1673	0.1691	0.1709	0.1727	0.1745	3	6	9	12	15
10	0.1763	0.1781	0.1799	0.1817	0.1835	0.1853	0.1871	0.1890	0.1908	0.1926	3	6	9	12	15
11	0.1944	0.1962	0.1980	0.1998	0.2016	0.2035	0.2053	0.2071	0.2089	0.2107	3	6	9	12	15
12	0.2126	0.2144	0.2162	0.2180	0.2199	0.2217	0.2235	0.2254	0.2272	0.2290	3	6	9	12	15
13	0.2309	0.2327	0.2345	0.2364	0.2382	0.2401	0.2419	0.2438	0.2456	0.2475	3	6	9	12	15
14	0.2493	0.2512	0.2530	0.2549	0.2568	0.2586	0.2605	0.2623	0.2642	0.2661	3	6	9	12	15
15	0.2679	0.2698	0.2717	0.2736	0.2754	0.2773	0.2792	0.2811	0.2830	0.2849	3	6	9	12	15
16	0.2867	0.2886	0.2905	0.2924	0.2943	0.2962	0.2981	0.3000	0.3019	0.3038	3	6	9	12	15
17	0.3057	0.3076	0.3096	0.3115	0.3134	0.3153	0.3172	0.3191	0.3211	0.3230	3	6	9	12	15
18	0.3249	0.3269	0.3288	0.3307	0.3327	0.3346	0.3365	0.3385	0.3404	0.3424	3	6	9	12	15
19	0.3443	0.3463	0.3482	0.3502	0.3522	0.3541	0.3561	0.3581	0.3600	0.3620	3	6	9	12	15
20	0.3640	0.3659	0.3679	0.3699	0.3719	0.3739	0.3759	0.3779	0.3799	0.3819	3	6	9	12	15
21	0.3839	0.3859	0.3879	0.3899	0.3919	0.3939	0.3959	0.3979	0.4000	0.4020	3	6	9	12	15

	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°
22	0.4040	4061	4081	4101	4122	4142	4163	4183	4204	4224	3	7	10	14	17
23	0.4245	4265	4286	4307	4327	4348	4369	4390	4411	4431	3	7	10	14	17
24	0.4452	4473	4494	4515	4536	4557	4578	4599	4621	4642	4	7	11	14	18
25	0.4663	4684	4706	4727	4748	4770	4791	4813	4834	4856	4	7	11	14	18
26	0.4877	4899	4921	4942	4964	4986	5008	5029	5051	5073	4	7	11	15	18
27	0.5095	5117	5139	5161	5184	5206	5228	5250	5272	5295	4	7	11	15	18
28	0.5317	5340	5362	5384	5407	5430	5452	5475	5498	5520	4	8	11	15	19
29	0.5533	5566	5589	5612	5635	5658	5681	5704	5727	5750	4	8	12	15	19
30	0.5774	5797	5820	5844	5867	5890	5914	5938	5961	5985	4	8	12	16	20
31	0.6009	6032	6056	6080	6104	6128	6152	6176	6200	6224	4	8	12	16	20
32	0.6249	6273	6297	6322	6346	6371	6395	6420	6445	6469	4	8	12	16	20
33	0.6494	6519	6544	6569	6594	6619	6644	6669	6694	6720	4	8	12	16	20
34	0.6745	6771	6796	6822	6847	6873	6899	6924	6950	6976	4	9	13	17	21
35	0.7002	7028	7054	7080	7107	7133	7159	7186	7212	7239	4	9	13	18	22
36	0.7265	7292	7319	7346	7373	7400	7427	7454	7481	7508	5	9	14	18	23
37	0.7536	7563	7590	7618	7646	7674	7701	7729	7757	7785	5	9	14	18	23
38	0.7813	7841	7869	7898	7926	7954	7983	8012	8040	8069	5	9	14	19	24
39	0.8098	8127	8156	8185	8214	8243	8273	8302	8332	8361	5	10	15	20	24
40	0.8391	8421	8451	8481	8511	8541	8571	8601	8632	8662	5	10	15	20	25
41	0.8693	8724	8754	8783	8816	8847	8878	8910	8941	8972	5	10	16	21	26
42	0.9004	9036	9067	9099	9131	9163	9195	9228	9260	9293	5	11	16	21	27
43	0.9325	9358	9391	9424	9457	9490	9523	9556	9590	9623	6	11	17	22	28
44	0.9657	9691	9725	9759	9827	9861	9896	9930	9965	9995	6	11	17	23	29
	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°

NATURAL TANGENTS

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
45°	1.0000	0.035	0.070	0.105	0.141	0.176	0.212	0.247	0.283	0.319	6	12	18	24	30
46	1.0355	0.0392	0.0428	0.0464	0.0501	0.0538	0.0575	0.0612	0.0649	0.0686	6	12	18	25	31
47	1.0724	0.0761	0.0799	0.0837	0.0913	0.0951	0.0990	0.1028	0.1067	0.1067	6	13	19	25	32
48	1.1106	1.145	1.184	1.224	1.263	1.303	1.343	1.383	1.423	1.463	7	13	20	26	33
49	1.1504	1.544	1.585	1.626	1.667	1.708	1.750	1.792	1.833	1.875	7	14	21	28	34
50	1.1918	1.960	2.002	2.045	2.088	2.131	2.174	2.218	2.261	2.305	7	14	22	29	36
51	1.2349	2.393	2.437	2.482	2.527	2.572	2.617	2.662	2.708	2.753	8	15	23	30	38
52	1.2799	2.846	2.892	2.938	2.985	3.032	3.079	3.127	3.175	3.222	8	16	24	31	39
53	1.3270	3.319	3.367	3.416	3.465	3.514	3.564	3.613	3.663	3.713	9	17	25	33	41
54	1.3764	3.814	3.863	3.916	3.968	4.019	4.071	4.124	4.176	4.229	9	17	26	34	43
55	1.4281	4.335	4.388	4.442	4.496	4.550	4.605	4.659	4.715	4.770	9	18	27	36	45
56	1.4826	4.882	4.938	4.994	5.051	5.108	5.166	5.224	5.282	5.340	10	19	29	38	48
57	1.5399	5.458	5.517	5.577	5.637	5.697	5.757	5.818	5.880	5.941	10	20	30	40	50
58	1.6003	6.066	6.128	6.191	6.255	6.319	6.383	6.447	6.512	6.577	11	21	32	43	53
59	1.6643	6.709	6.775	6.842	6.909	6.977	7.045	7.113	7.182	7.251	11	23	34	45	56
60	1.7321	7.391	7.461	7.532	7.603	7.675	7.747	7.820	7.893	7.966	12	24	36	48	60
61	1.8040	8.115	8.190	8.265	8.341	8.418	8.495	8.572	8.650	8.728	13	26	38	51	64
62	1.8807	8.887	8.967	9.047	9.128	9.210	9.292	9.375	9.458	9.542	14	27	41	55	68
63	1.9626	9.711	9.797	9.883	9.970	1.0057	1.045	1.0233	1.0323	1.0413	15	29	44	58	73
64	2.0503	1.0594	1.0866	1.0778	1.0872	1.0965	1.1060	1.1155	1.1251	1.1348	16	31	47	63	78
65	2.1445	1.543	1.642	1.742	1.842	1.943	2.045	2.148	2.251	2.355	17	34	51	68	83
66	2.2460	2.566	2.673	2.781	2.889	2.998	3.109	3.220	3.322	3.445	18	37	55	73	91

67	2.3559	3.789	3.906	4.023	4.142	4.262	4.383	4.504	4.627	4.75	20	40	60	79	99
68	2.4751	4.876	5.002	5.129	5.257	5.386	5.517	5.649	5.782	5.916	22	43	65	87	108
69	2.6051	6.187	6.325	6.464	6.605	6.746	6.889	7.034	7.179	7.326	24	47	71	95	119
70	2.7475	7.625	7.776	7.929	8.083	8.239	8.397	8.556	8.716	8.878	26	52	78	104	130
71	2.9042	9.208	9.375	9.544	9.714	9.887	10.061	10.237	10.415	10.595	29	58	87	116	144
72	3.0777	1.061	1.146	1.334	1.524	1.716	1.910	2.106	2.303	2.506	32	64	97	129	161
73	3.2709	2.914	3.122	3.332	3.544	3.759	3.977	4.197	4.420	4.646	36	72	108	144	180
74	3.4874	5.105	5.339	5.576	5.816	6.059	6.305	6.554	6.806	7.062	41	81	122	163	203
75	3.7321	7.583	7.848	8.118	8.391	8.667	8.947	9.232	9.520	9.812	46	93	139	186	232
76	4.0108	1.048	1.0713	1.022	1.135	1.653	1.976	2.303	2.635	2.972	53	107	160	214	267
77	4.3315	3.662	4.015	4.373	4.737	5.107	5.483	5.864	6.252	6.646	62	124	186	248	310
78	4.7046	7.453	7.867	8.288	8.716	9.152	9.594	10.045	10.504	10.970	73	146	220	293	366
79	5.1446	1.929	2.422	2.924	3.435	3.955	4.486	5.026	5.578	6.140	175	263	350	438	518
	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	20	40	60	79	99

Differences
untrustworthy
here

The black type indicates that the integer changes.

NATURAL COTANGENTS

SUBTRACT

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
0°	573.0	286.5	191.0	143.2	114.6	95.49	81.85	71.62	63.66						
1	572.9	52.08	47.74	44.07	40.92	38.19	35.80	33.69	31.82	30.14					
2	28.64	27.27	26.03	24.90	23.86	22.90	22.02	21.20	20.45	19.74					
3	19.08	18.46	17.89	17.34	16.83	16.35	15.89	15.46	15.05	14.67					
4	14.30		13.95	13.62	13.30	12.71	12.43	12.16	11.91	11.66					
5	11.43	11.20	10.99	10.78	10.58	10.39	10.20	10.02	9.84	9.68					
6	9.514	9.357	9.205	9.058	8.915	8.777	8.643	8.513	8.386	8.264					
7	8.144	8.028	7.916	7.806	7.700	7.596	7.495	7.396	7.300	7.207					
8	7.115	7.026	6.940	6.855	6.772	6.691	6.612	6.535	6.460	6.386					
9	6.314	6.243	6.174	6.107	6.041	5.976	5.912	5.850	5.789	5.730					
10	5.6713	6140	5578	5026	4486	3955	3435	2924	2422	1929	87	175	263	350	438
11	5.1446	0970	0504	0045	9594	9152	8716	8288	7867	7453	73	146	220	293	366
12	4.7046	6646	6252	5864	5483	5107	4737	4373	4015	3662	62	124	186	248	310
13	4.3315	2972	2635	2303	1976	1653	1335	1022	7013	0408	53	107	160	214	267
14	4.0108	9812	9520	9232	8947	8667	8391	8118	7848	7583	46	93	139	186	232
15	3.7321	7062	6806	6354	6305	6059	5816	5576	5339	5105	41	81	122	163	203
16	3.4874	4646	4420	4197	3977	3759	3544	3332	3122	2914	36	72	108	144	180
17	3.2109	2506	2305	2106	1910	1716	1524	1334	1146	0961	32	64	97	129	161
18	3.0777	0595	0415	0237	0061	9887	9714	9544	9375	9208	29	58	87	116	144
19	2.9042	8878	8716	8556	8397	8239	8083	7929	7776	7625	52	78	104	130	
20	2.7475	7326	7179	7034	6889	6746	6605	6464	6325	5902	22	47	71	95	119
21	2.6051	5916	5782	5649	5517	5386	5257	5129	4876	4876	43	65	87	103	

Differences
untrustworthy
here

22	4.627	4504	4383	4262	4142	4023	3906	3789	3673	20					
23	2.3559	3445	3332	3220	3109	2998	2889	2781	2673	18					
24	2.2460	2355	2251	2148	2045	1943	1842	1742	1642	1543	17				
25	2.1445	1348	1251	1155	1060	0965	0872	0778	0686	0594	16				
26	2.0503	0413	0323	0233	0145	0057	0057	0057	0057	0057	16				
27	1.9626	9542	9458	9375	9292	9210	9128	9047	8963	8977	15				
28	1.8807	8728	8650	8572	8495	8418	8341	8265	8190	8115	13				
29	1.8040	7966	7893	7820	7747	7675	7603	7532	7461	7391	12				
30	1.7321	7251	7182	7113	7045	6977	6909	6842	6775	6709	11				
31	1.6643	6577	6512	6447	6383	6319	6255	6191	6128	6066	11				
32	1.6003	5941	5880	5818	5757	5697	5637	5577	5517	5458	10				
33	1.5399	5340	5282	5224	5166	5108	5051	4994	4938	4882	9				
34	1.4826	4770	4715	4659	4605	4550	4496	4442	4388	4335	9				
35	1.4281	4229	4176	4124	4071	4019	3968	3916	3865	3814	9				
36	1.3764	3713	3663	3613	3564	3514	3465	3416	3367	3319	8				
37	1.3270	3222	3175	3127	3079	3032	2985	2938	2892	2846	8				
38	1.2799	2753	2708	2662	2617	2572	2527	2482	2437	2393	8				
39	1.2349	2305	2261	2218	2174	2131	2088	2045	2002	1960	7				
40	1.1918	1875	1833	1792	1750	1708	1667	1626	1585	1544	7				
41	1.1504	1463	1423	1383	1343	1303	1263	1224	1184	1145	7				
42	1.1106	1067	1028	9990	9591	9113	8753	8387	7990	7661	6				
43	1.0724	0686	0649	0612	0575	0538	0501	0464	0428	0392	6				
44	1.0355	0319	0283	0247	0212	0176	0141	0105	0070	0035	6				
	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'

The black type indicates that the integer changes.

NATURAL COTANGENTS

SUBTRACT

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
45°	1.0000	9965	9930	9896	9861	9827	9793	9759	9725	9691	6	11	17	23	29
46	0.9657	9623	9556	9523	9490	9457	9424	9391	9358	6	11	17	22	28	
47	0.9325	9293	9228	9260	9195	9163	9131	9099	9067	5	11	16	21	27	
48	0.9004	8972	8941	8910	8878	8847	8816	8785	8754	5	10	16	21	26	
49	0.8693	8662	8632	8601	8571	8541	8511	8481	8451	8421	5	10	15	20	25
50	0.8391	8361	8332	8302	8273	8243	8214	8185	8156	8127	5	10	15	20	24
51	0.8098	8069	8040	8012	7983	7954	7926	7898	7869	7841	5	9	14	19	24
52	0.7813	7785	7757	7729	7701	7673	7646	7618	7590	7563	5	9	14	18	23
53	0.7536	7508	7481	7454	7427	7400	7373	7346	7319	7292	5	9	14	18	23
54	0.7265	7239	7212	7186	7159	7133	7107	7080	7054	7028	4	9	13	18	22
55	0.7002	6976	6950	6924	6899	6873	6847	6822	6796	6771	4	9	13	17	21
56	0.6745	6720	6694	6669	6644	6619	6594	6569	6544	6519	4	8	13	17	21
57	0.6494	6469	6445	6420	6395	6371	6346	6322	6297	6273	4	8	12	16	20
58	0.6249	6224	6200	6176	6152	6128	6104	6080	6056	6032	4	8	12	16	20
59	0.6009	5985	5961	5938	5914	5890	5867	5844	5820	5797	4	8	12	16	20
60	0.5774	5750	5727	5704	5681	5658	5635	5612	5589	5566	4	8	12	15	19
61	0.5543	5520	5498	5475	5452	5430	5407	5384	5362	5340	4	8	11	15	19
62	0.5317	5295	5272	5250	5228	5206	5184	5161	5139	5117	4	7	11	15	18
63	0.5095	5073	5051	5029	5008	4986	4964	4942	4921	4899	4	7	11	15	18
64	0.4877	4856	4834	4813	4791	4770	4748	4727	4706	4684	4	7	11	14	18
65	0.4663	4642	4621	4599	4578	4557	4536	4515	4494	4473	4	7	11	14	18
66	0.4452	4431	4411	4390	4369	4348	4327	4307	4286	4265	3	7	10	14	17

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
67	0.4245	4183	4163	4142	4122	4101	4081	4061	4041	4021	3	7	10	14	17
68	0.4040	4020	3979	3959	3939	3919	3899	3879	3859	3839	3	7	10	13	17
69	0.3839	3819	3779	3759	3739	3719	3699	3679	3659	3639	3	7	10	13	17
70	0.3640	3620	3600	3581	3561	3541	3522	3502	3482	3463	3	7	10	13	16
71	0.3443	3424	3404	3385	3365	3346	3327	3307	3288	3269	3	6	9	12	16
72	0.3249	3230	3211	3191	3172	3153	3134	3115	3096	3076	3	6	9	12	16
73	0.3057	3038	3019	3000	2981	2962	2943	2924	2905	2886	3	6	9	12	16
74	0.2867	2849	2830	2811	2792	2773	2754	2736	2717	2698	3	6	9	13	16
75	0.2679	2661	2642	2623	2605	2586	2568	2549	2530	2512	3	6	9	12	16
76	0.2493	2475	2456	2438	2419	2401	2382	2364	2345	2327	3	6	9	12	15
77	0.2309	2290	2272	2254	2235	2217	2199	2180	2162	2144	3	6	9	12	15
78	0.2126	2107	2089	2071	2053	2035	2016	1998	1980	1962	3	6	9	12	15
79	0.1944	1926	1908	1890	1871	1853	1835	1817	1799	1781	3	6	9	12	15
80	0.1763	1745	1727	1709	1691	1673	1655	1638	1620	1602	3	6	9	12	15
81	0.1584	1566	1548	1530	1512	1495	1477	1459	1441	1423	3	6	9	12	15
82	0.1405	1388	1370	1352	1334	1317	1299	1281	1263	1246	3	6	9	12	15
83	0.1228	1210	1192	1175	1157	1139	1122	1104	1086	1069	3	6	9	12	15
84	0.1051	1033	1016	998	981	963	945	928	9010	892	3	6	9	12	15
85	0.0875	0857	0840	0822	0805	0787	0769	0752	0734	0717	3	6	9	12	15
86	0.0699	0682	0664	0647	0629	0612	0594	0577	0559	0542	3	6	9	12	15
87	0.0524	0507	0489	0472	0454	0437	0419	0402	0384	0367	3	6	9	12	15
88	0.0349	0332	0314	0297	0279	0262	0244	0227	0209	0192	3	6	9	12	15
89	0.0175	0157	0140	0122	0105	0087	0070	0052	0035	0017	3	6	9	12	15
	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'

The black type indicates that the integer changes.

NATURAL SECANTS

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	V	2'	3'	4'	5'
0°	1-0000	0000	0000	0000	0000	0000	0000	0001	0001	0001	0001	0001	0001	0001	0001
1	1-0002	0002	0002	0003	0003	0004	0004	0005	0005	0006	0006	0006	0006	0006	0006
2	1-0006	0007	0007	0008	0009	0010	0010	0011	0011	0012	0012	0012	0012	0012	0012
3	1-0014	0015	0016	0017	0018	0019	0020	0021	0022	0023	0023	0023	0023	0023	0023
4	1-0024	0026	0027	0028	0030	0031	0032	0034	0035	0037	0037	0037	0037	0037	0037
5	1-0038	0040	0041	0043	0045	0046	0048	0050	0051	0053	0053	0053	0053	0053	0053
6	1-0055	0057	0059	0061	0063	0065	0067	0069	0071	0073	0073	0073	0073	0073	0073
7	1-0075	0077	0079	0082	0084	0086	0089	0091	0093	0096	0096	0096	0096	0096	0096
8	1-0098	0101	0103	0106	0108	0111	0114	0116	0119	0122	0122	0122	0122	0122	0122
9	1-0125	0127	0130	0133	0136	0139	0142	0145	0148	0151	0151	0151	0151	0151	0151
10	1-0154	0157	0161	0164	0167	0170	0174	0177	0180	0184	0184	0184	0184	0184	0184
11	1-0187	0191	0194	0198	0201	0205	0209	0212	0215	0220	0220	0220	0220	0220	0220
12	1-0223	0227	0231	0235	0239	0243	0247	0251	0255	0259	0259	0259	0259	0259	0259
13	1-0263	0267	0271	0276	0280	0284	0288	0293	0297	0302	0302	0302	0302	0302	0302
14	1-0306	0311	0315	0320	0324	0329	0334	0338	0343	0348	0348	0348	0348	0348	0348
15	1-0353	0358	0363	0367	0372	0377	0382	0388	0393	0398	0398	0398	0398	0398	0398
16	1-0403	0408	0413	0419	0424	0429	0435	0440	0446	0451	0451	0451	0451	0451	0451
17	1-0457	0463	0468	0474	0480	0485	0491	0497	0503	0509	0509	0509	0509	0509	0509
18	1-0515	0521	0527	0533	0539	0545	0551	0557	0564	0570	0570	0570	0570	0570	0570
19	1-0576	0583	0589	0595	0602	0608	0615	0622	0628	0635	0635	0635	0635	0635	0635
20	1-0642	0649	0655	0662	0669	0676	0683	0690	0697	0704	0704	0704	0704	0704	0704
21	1-0711	0719	0726	0733	0740	0748	0755	0763	0770	0778	0778	0778	0778	0778	0778

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	V	2'	3'	4'	5'
0°	1-0000	0000	0000	0000	0000	0000	0000	0001	0001	0001	0001	0001	0001	0001	0001
1	1-0002	0002	0002	0003	0003	0004	0004	0005	0005	0006	0006	0006	0006	0006	0006
2	1-0006	0007	0007	0008	0009	0010	0010	0011	0011	0012	0012	0012	0012	0012	0012
3	1-0014	0015	0016	0017	0018	0019	0020	0021	0022	0023	0023	0023	0023	0023	0023
4	1-0024	0026	0027	0028	0030	0031	0032	0034	0035	0037	0037	0037	0037	0037	0037
5	1-0038	0040	0041	0043	0045	0046	0048	0050	0051	0053	0053	0053	0053	0053	0053
6	1-0055	0057	0059	0061	0063	0065	0067	0069	0071	0073	0073	0073	0073	0073	0073
7	1-0075	0077	0079	0082	0084	0086	0089	0091	0093	0096	0096	0096	0096	0096	0096
8	1-0098	0101	0103	0106	0108	0111	0114	0116	0119	0122	0122	0122	0122	0122	0122
9	1-0125	0127	0130	0133	0136	0139	0142	0145	0148	0151	0151	0151	0151	0151	0151
10	1-0154	0157	0161	0164	0167	0170	0174	0177	0180	0184	0184	0184	0184	0184	0184
11	1-0187	0191	0194	0198	0201	0205	0209	0212	0216	0220	0220	0220	0220	0220	0220
12	1-0223	0227	0231	0235	0239	0243	0247	0251	0255	0259	0259	0259	0259	0259	0259
13	1-0263	0267	0271	0276	0280	0284	0288	0293	0297	0302	0302	0302	0302	0302	0302
14	1-0306	0311	0315	0320	0324	0329	0334	0338	0343	0348	0348	0348	0348	0348	0348
15	1-0353	0358	0363	0367	0372	0377	0382	0388	0393	0398	0398	0398	0398	0398	0398
16	1-0403	0408	0413	0419	0424	0429	0435	0440	0446	0451	0451	0451	0451	0451	0451
17	1-0457	0463	0468	0474	0480	0485	0491	0497	0503	0509	0509	0509	0509	0509	0509
18	1-0515	0521	0527	0533	0539	0545	0551	0557	0564	0570	0570	0570	0570	0570	0570
19	1-0576	0583	0589	0595	0602	0608	0615	0622	0628	0635	0635	0635	0635	0635	0635
20	1-0642	0649	0655	0662	0669	0676	0683	0690	0697	0704	0704	0704	0704	0704	0704
21	1-0711	0719	0726	0733	0740	0748	0755	0763	0770	0778	0778	0778	0778	0778	0778
22	1-0785	0801	0808	0816	0824	0832	0840	0848	0856	0864	0873	0881	0889	0897	0905
23	1-0864	0872	0880	0888	0896	0904	0913	0921	0929	0938	0946	0954	0962	0970	0978
24	1-0946	0955	0963	0972	0981	0989	0998	1007	1016	1025	1034	1042	1050	1058	1066
25	1-1034	1043	1052	1061	1070	1079	1089	1098	1107	1117	1126	1135	1144	1153	1162
26	1-1126	1136	1145	1155	1164	1174	1184	1194	1203	1213	1223	1233	1243	1253	1263
27	1-1223	1233	1243	1253	1264	1274	1284	1294	1305	1315	1325	1335	1345	1355	1365
28	1-1326	1336	1347	1357	1368	1379	1390	1401	1412	1423	1433	1443	1453	1463	1473
29	1-1434	1445	1456	1467	1478	1490	1501	1512	1524	1535	1545	1555	1565	1575	1585
30	1-1547	1559	1570	1582	1594	1606	1618	1630	1642	1654	1666	1677	1688	1699	1710
31	1-1666	1679	1691	1703	1716	1728	1741	1753	1766	1779	1791	1802	1813	1824	1835
32	1-1792	1805	1818	1831	1844	1857	1870	1883	1897	1910	1922	1934	1946	1958	1970
33	1-1924	1937	1951	1964	1978	1992	2006	2020	2034	2048	2062	2075	2088	2101	2114
34	1-2062	2223	2238	2253	2268	2283	2299	2314	2329	2345	2361	2377	2393	2409	2426
35	1-2208	2376	2392	2408	2424	2440	2456	2472	2489	2505	2521	2537	2553	2569	2585
36	1-2361	2538	2554	2571	2588	2605	2622	2639	2656	2673	2689	2705	2721	2737	2753
37	1-2521	2708	2725	2742	2760	2778	2795	2813	2831	2849	2865	2881	2897	2913	2930
38	1-2868	2886	2904	2923	2941	2960	2978	2997	3016	3035	3053	3071	3089	3107	3125
39	1-3054	3073	3093	3112	3131	3151	3171	3190	3210	3230	3250	3270	3290	3310	3330
40	1-3250	3270	3291	3311	3331	3352	3373	3393	3414	3435	3455	3475	3495	3515	3535
41	1-3456	3478	3499	3520	3542	3563	3585	3607	3629	3651	3671	3691	3711	3731	3751
42	1-3673	3696	3718	3741	3763	3786	3809	3832	3855	3878	3901	3921	3941	3961	3981
43	1-3902	3925	3949	3972	3996	4020	4044	4069	4093	4118	4141	4161	4181	4201	4221
44	1-4124	4151	4175	4200	4225	4250	4275	4300	4325	4350	4375	4400	4425	4450	4475
	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	V	2'	3'	4'	5'

NATURAL SECANTS

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
45°	1.4142	4167	4192	4217	4242	4267	4293	4318	4344	4370	4	8	13	17	21
46	1.4396	4422	4448	4474	4501	4527	4554	4581	4608	4635	4	9	13	18	22
47	1.4663	4690	4718	4746	4774	4802	4830	4859	4887	4916	5	9	14	19	23
48	1.4945	4974	5003	5032	5062	5092	5121	5151	5182	5212	5	10	15	20	25
49	1.5243	5273	5304	5335	5366	5398	5429	5461	5493	5525	5	10	16	21	26
50	1.5557	5590	5622	5655	5688	5721	5755	5788	5822	5856	6	11	17	22	28
51	1.5890	5925	5959	5994	6029	6064	6099	6135	6171	6207	6	12	18	23	29
52	1.6243	6279	6316	6353	6390	6427	6464	6502	6540	6578	6	12	19	25	31
53	1.6616	6655	6694	6733	6772	6812	6852	6892	6932	6972	7	13	20	26	33
54	1.7013	7054	7095	7137	7179	7221	7263	7305	7348	7391	7	14	21	28	35
55	1.7434	7478	7522	7566	7610	7655	7700	7745	7791	7837	7	15	22	30	37
56	1.7883	7929	7976	8023	8070	8118	8166	8214	8263	8312	8	16	24	32	40
57	1.8361	8410	8460	8510	8561	8612	8663	8714	8766	8818	8	17	25	34	42
58	1.8871	8924	8977	9031	9084	9139	9194	9249	9304	9360	9	18	27	36	45
59	1.9416	9473	9530	9587	9645	9703	9762	9821	9880	9940	10	19	29	39	49
60	2.0000	0061	0122	0183	0245	0308	0371	0434	0498	0562	10	10	21	31	42
61	2.0627	0692	0757	0824	0890	0957	1025	1093	1162	1231	11	22	34	45	56
62	2.1301	1371	1441	1513	1584	1657	1730	1803	1877	1952	12	24	36	48	61
63	2.2027	2103	2179	2256	2333	2412	2490	2570	2650	2730	13	26	39	52	65
64	2.2812	2894	2974	3056	3144	3228	3314	3400	3486	3574	14	28	43	57	71
65	2.3662	3751	3841	3931	4022	4114	4207	4300	4395	4490	15	31	46	62	77
66	2.4586	4683	4780	4879	4978	5078	5180	5282	5384	5488	17	34	50	67	84

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
67	2.5593	5699	5805	5913	6022	6131	6242	6354	6466	6580	18	37	53	73	92
68	2.6695	6811	6927	7046	7165	7285	7407	7525	7653	7778	20	40	60	81	101
69	2.7904	8032	8161	8291	8422	8555	8688	8824	8960	9099	22	44	67	89	111
70	2.9238	9379	9521	9665	9811	9957	0106	0256	0407	0561	25	49	74	98	123
71	3.0716	0872	1030	1190	1352	1515	1681	1848	2017	2188	27	55	82	110	137
72	3.2361	2535	2712	2891	3072	3255	3440	3628	3817	4009	31	61	92	123	153
73	3.4203	4399	4598	4799	5003	5209	5418	5629	5843	6060	35	69	104	138	173
74	3.6280	6502	6727	6955	7186	7420	7657	7897	8140	8387	39	79	118	157	196
75	3.8637	8890	9147	9408	9672	9939	0211	0486	0765	1048	45	90	135	180	225
76	4.1336	1627	1923	2223	2527	2837	3150	3469	3792	4121	52	104	156	207	260
77	4.4454	4793	5137	5486	5841	6202	6569	6942	7321	7706	61	121	182	242	303
78	4.8097	8496	8901	9313	9732	0159	0593	1034	1484	1942	72	143	215	287	359
79	5.2408	2883	3367	3860	4362	4874	5396	5928	6470	7023	86	172	258	341	431
80	5.759	5816	5875	5935	5996	6059	6123	6188	6255	6323					
81	6.392	6464	6537	6611	6687	6765	6845	6927	7011	7097					
82	7.185	7276	7368	7463	7561	7661	7764	7870	7979	8091					
83	8.206	8324	8446	8571	8700	8834	8971	9113	9259	9411					
84	9.57	973	990	1007	1025	1043	1063	1083	1103	1125					
85	11.47	1171	1195	1220	1247	1275	1303	1334	1365	1399					
86	14.34	1470	1509	1550	1593	1638	1686	1737	1791	1849					
87	19.11	1977	2047	2123	2204	2293	2388	2492	2605	2729					
88	28.65	3016	3184	3371	3581	3820	4093	4408	4775	5209					
89	57.30	6366	7162	8185	9549	1146	1432	1910	2865	5730					
	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'

Differences
untrustworthy
here

The black type indicates that the integer changes.

NATURAL COSECANTS

	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°
0°	∞	573.0	286.5	191.0	143.2	114.6	95.49	81.85	71.62	63.66	53.16	43.66	33.71	23.84	13.84
1	57.30	52.09	47.75	44.08	40.93	38.20	35.81	33.71	31.84	30.16	21.23	20.47	19.77	15.50	15.09
2	28.65	27.29	26.05	24.92	23.88	22.93	22.04	21.23	20.47	19.77	17.37	16.86	15.93	15.50	14.70
3	19.11	18.49	17.91	17.37	16.86	16.38	15.93	15.50	15.09	14.70	13.99	13.65	13.34	13.03	12.47
4	14.34	13.99	13.65	13.34	13.03	12.75	12.47	12.20	11.95	11.71	Differences untrustworthy here				
5	11.47	11.25	11.03	10.83	10.63	10.43	10.25	10.07	9.90	9.73					
6	9.567	9.411	9.259	9.113	8.971	8.834	8.700	8.571	8.446	8.324					
7	8.206	8.091	7.979	7.870	7.764	7.661	7.463	7.368	7.276						
8	7.185	7.097	7.011	6.927	6.845	6.765	6.687	6.611	6.537	6.464					
9	6.392	6.323	6.255	6.188	6.123	6.059	5.996	5.935	5.875	5.816					
10	5.7588	7.023	6.470	5.928	5.396	4.874	4.362	3.860	3.367	2.883					
11	5.2408	1942	1484	1034	0393	0159	9732	9213	8901	8496	72	172	258	344	431
12	4.8097	7706	7321	6942	6569	6202	5841	5486	5137	4793	61	143	215	287	359
13	4.4454	4121	3792	3469	3150	2837	2527	2223	1923	1627	52	104	156	207	303
14	4.1336	1048	0765	0486	0211	9939	9672	9408	9147	8890	45	90	135	180	225
15	3.8637	8387	8140	7897	7657	7420	7186	6955	6727	6502	39	79	118	157	196
16	3.6280	6060	5843	5629	5418	5209	5003	4799	4598	4399	35	69	104	138	173
17	3.4203	4009	3817	3628	3440	3255	3072	2891	2712	2535	31	61	92	123	153
18	3.2361	2188	2017	1848	1681	1515	1352	1190	1030	0872	27	55	82	110	137
19	3.0716	0561	0407	0256	0106	9957	9811	9665	9521	9379	25	49	74	98	123
20	2.9238	9099	8960	8824	8688	8555	8422	8291	8161	8032	22	44	67	89	111
21	2.7904	7778	7653	7529	7407	7285	7165	7046	6927	6811	20	40	60	81	101

	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°
22	2.6695	6580	5384	5282	5180	5078	4978	4879	4780	4683	18	5699	18	37	92
23	2.5593	5488	4395	4300	4207	4114	4022	3931	3841	3751	15	31	46	62	84
24	2.4586	4490													77
25	2.36662	3574	3486	3400	3314	3228	3144	3060	2976	2894	14	28	43	57	71
26	2.2812	2730	2650	2490	2412	2333	2256	2179	2103	2035	13	26	39	52	65
27	2.2027	1952	1877	1803	1730	1657	1584	1513	1441	1371	12	24	36	48	61
28	2.1301	1231	1162	1093	1025	957	0890	0824	0757	0692	11	22	34	45	56
29	2.0627	0562	0498	0434	0371	0308	0245	0183	0122	0061	10	21	31	42	52
30	2.0000	9940	9880	9821	9762	9703	9645	9587	9530	9473	10	19	29	39	49
31	1.9416	9360	9304	9249	9194	9139	9084	9031	8977	8924	9	18	27	36	45
32	1.8871	8818	8766	8714	8663	8612	8561	8510	8460	8410	8	17	25	34	42
33	1.8361	8312	8263	8214	8166	8118	8070	8023	7976	7929	8	16	24	32	40
34	1.7883	7837	7791	7745	7700	7655	7610	7566	7522	7478	7	15	22	30	37
35	1.7434	7391	7348	7305	7263	7221	7179	7137	7095	7054	7	14	21	28	35
36	1.7013	6972	6932	6892	6852	6812	6772	6733	6694	6655	7	13	20	26	33
37	1.6616	6578	6540	6502	6464	6427	6390	6353	6316	6279	6	12	19	25	31
38	1.6243	6207	6171	6135	6099	6064	5994	5959	5925	5890	6	11	17	22	28
39	1.5890	5856	5822	5788	5755	5721	5688	5655	5622	5590	6	11	17	22	28
40	1.5557	5525	5493	5461	5429	5398	5366	5335	5304	5273	5	10	16	21	26
41	1.5243	5212	5182	5151	5121	5092	5062	5032	5003	4874	5	10	15	20	25
42	1.4945	4916	4887	4859	4830	4802	4774	4746	4718	4690	5	9	14	19	23
43	1.4663	4635	4608	4581	4554	4527	4501	4474	4448	4422	4	9	13	18	22
44	1.4396	4370	4344	4318	4293	4267	4242	4217	4192	4167	4	8	13	17	21
	0°	6°	12°	18°	24°	30°	36°	42°	48°	54°	1°	2°	3°	4°	5°

The black type indicates that the integer changes.

NATURAL COSECANTS

SUBTRACT

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
45°	1.4142	4118	4093	4069	4044	4020	3996	3972	3949	3925	4	8	12	16	20
46	1.3902	3878	3855	3832	3809	3786	3763	3741	3718	3695	4	8	12	16	20
47	1.3673	3651	3629	3607	3585	3563	3542	3520	3499	3478	4	7	11	14	18
48	1.3456	3435	3414	3393	3373	3352	3331	3311	3291	3270	3	7	10	14	17
49	1.3250	3230	3210	3190	3171	3151	3131	3112	3093	3073	3	7	10	13	16
50	1.3054	3035	3016	2997	2978	2960	2941	2923	2904	2886	3	6	9	12	16
51	1.2868	2849	2831	2813	2796	2778	2760	2742	2725	2708	3	6	9	12	16
52	1.2690	2673	2656	2639	2622	2605	2588	2571	2554	2538	3	6	8	11	14
53	1.2521	2505	2489	2472	2456	2440	2424	2408	2392	2376	3	5	8	10	13
54	1.2361	2345	2329	2314	2299	2283	2268	2253	2238	2223	3	5	8	10	13
55	1.2208	2193	2178	2163	2149	2134	2120	2105	2091	2076	2	5	7	10	12
56	1.2062	2048	2034	2020	2006	1992	1978	1964	1951	1937	2	5	7	9	12
57	1.1924	1910	1897	1883	1870	1857	1844	1831	1818	1805	2	4	7	9	11
58	1.1792	1779	1766	1753	1741	1728	1716	1703	1691	1679	2	4	6	8	10
59	1.1666	1654	1642	1630	1618	1606	1594	1582	1570	1559	2	4	6	8	10
60	1.1547	1535	1524	1512	1501	1490	1478	1467	1456	1445	2	4	6	8	9
61	1.1424	1423	1412	1401	1390	1379	1368	1357	1347	1336	2	4	5	7	9
62	1.1326	1315	1305	1294	1284	1274	1264	1253	1243	1233	2	3	5	7	9
63	1.1223	1213	1203	1194	1184	1174	1164	1155	1145	1136	2	3	5	6	8
64	1.1126	1117	1107	1098	1089	1079	1070	1061	1052	1043	2	3	5	6	8
65	1.1034	1025	1016	1007	998	989	981	972	963	955	1	3	4	6	7
66	1.0946	0938	0929	0921	0913	0904	0895	0888	0880	0872	1	3	4	6	7

	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'
67	1.0864	0856	0848	0840	0832	0824	0816	0808	0801	0793	7	5	5	5	6
68	1.0785	0778	0770	0763	0755	0748	0740	0733	0726	0719	1	3	4	5	6
69	1.0711	0704	0697	0690	0683	0676	0669	0662	0655	0649	1	2	3	4	5
70	1.0642	0635	0628	0622	0615	0608	0602	0595	0589	0583	1	2	3	4	5
71	1.0576	0570	0564	0557	0551	0545	0539	0533	0527	0521	1	2	3	4	5
72	1.0515	0509	0503	0497	0491	0485	0480	0474	0468	0463	1	2	3	4	5
73	1.0457	0451	0446	0440	0435	0429	0424	0419	0413	0408	1	2	3	4	4
74	1.0403	0398	0393	0388	0382	0377	0372	0367	0363	0358	1	2	3	3	4
75	1.0353	0348	0343	0338	0334	0329	0324	0320	0315	0311	1	2	3	4	4
76	1.0306	0302	0297	0293	0288	0284	0280	0276	0271	0267	1	2	3	4	4
77	1.0263	0259	0255	0251	0247	0243	0239	0235	0231	0227	1	2	3	3	3
78	1.0223	0220	0216	0212	0209	0205	0201	0198	0194	0191	1	1	2	2	3
79	1.0187	0184	0180	0177	0174	0170	0167	0164	0161	0157	1	1	2	2	3
80	1.0154	0151	0148	0145	0142	0139	0136	0133	0130	0127	0	1	1	2	2
81	1.0125	0122	0119	0116	0114	0111	0108	0106	0103	0101	0	1	1	2	2
82	1.0098	0096	0093	0091	0089	0086	0084	0082	0079	0077	0	1	1	1	1
83	1.0075	0073	0071	0069	0067	0065	0063	0061	0059	0057	0	1	1	1	1
84	1.0055	0053	0051	0050	0048	0046	0045	0043	0041	0040	0	1	1	0	1
85	1.0038	0037	0035	0034	0032	0031	0030	0028	0027	0026	0	0	1	1	1
86	1.0024	0023	0022	0021	0020	0019	0018	0017	0016	0015	0	0	0	0	1
87	1.0014	0013	0012	0011	0010	0009	0008	0007	0007	0007	0	0	1	1	1
88	1.0006	0006	0005	0004	0003	0003	0003	0003	0003	0002	0	0	0	0	1
89	1.0002	0001	0001	0001	0001	0000	0000	0000	0000	0000	0	0	0	0	1
	0'	6'	12'	18'	24'	30'	36'	42'	48'	54'	1'	2'	3'	4'	5'

RECIPROCAKS

SUBTRACT

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
1.0	1.0000	·9901	·9804	·9709	·9615	·9524	·9434	·9346	·9259	·9174	·918	·9177	·9174	·9177	·918	·9177	·9174	·9177	·9182
1.1	·9091	·9009	·8929	·8830	·8772	·8696	·8621	·8547	·8457	·8403	·838	·832	·823	·815	·815	·815	·815	·815	·815
1.2	·8333	·8264	·8197	·8130	·8065	·8000	·7937	·7874	·7813	·7752	·761	·753	·745	·738	·732	·732	·732	·732	·732
1.3	·7692	·7634	·7576	·7519	·7463	·7407	·7353	·7299	·7246	·7194	·711	·716	·722	·727	·733	·744	·751	·758	·761
1.4	·7143	·7092	·7042	·6993	·6944	·6897	·6849	·6803	·6757	·6711	·6510	·6414	·6429	·6369	·6329	·6289	·6249	·6209	·6169
1.5	·6667	·6623	·6579	·6536	·6494	·6452	·6410	·6369	·6329	·6289	·6239	·6204	·6171	·6135	·6098	·5952	·5917	·5981	·5946
1.6	·6250	·6211	·6173	·6135	·6098	·6061	·6024	·5988	·5952	·5917	·5871	·5838	·5803	·5767	·5731	·5682	·5645	·5608	·5571
1.7	·5882	·5848	·5814	·5780	·5747	·5714	·5682	·5650	·5618	·5581	·5549	·5519	·5481	·5444	·5405	·5376	·5348	·5319	·5291
1.8	·5556	·5525	·5495	·5464	·5435	·5405	·5376	·5348	·5319	·5291	·5251	·5219	·5181	·5155	·5128	·5092	·5061	·5031	·5001
1.9	·5263	·5236	·5208	·5181	·5155	·5128	·5102	·5076	·5051	·5025	·5001	·4975	·4950	·4926	·4902	·4878	·4854	·4831	·4808
2.0	·5000	·4975	·4950	·4926	·4902	·4878	·4854	·4831	·4808	·4785	·4759	·4734	·4709	·4684	·4659	·4634	·4609	·4584	·4560
2.1	·4762	·4739	·4717	·4695	·4673	·4651	·4630	·4608	·4587	·4566	·4541	·4516	·4491	·4466	·4444	·4425	·4405	·4386	·4367
2.2	·4545	·4525	·4505	·4484	·4464	·4444	·4424	·4404	·4383	·4362	·4341	·4316	·4291	·4274	·4255	·4237	·4219	·4202	·4184
2.3	·4348	·4329	·4310	·4292	·4274	·4255	·4237	·4219	·4202	·4184	·4163	·4142	·4121	·4101	·4082	·4065	·4049	·4032	·4016
2.4	·4167	·4149	·4132	·4115	·4098	·4082	·4065	·4051	·4032	·4016	·4001	·3986	·3971	·3953	·3937	·3922	·3906	·3891	·3876
2.5	·4000	·3984	·3968	·3953	·3937	·3922	·3906	·3891	·3876	·3861	·3851	·3841	·3831	·3821	·3811	·3802	·3788	·3774	·3760
2.6	·3846	·3831	·3817	·3802	·3788	·3774	·3760	·3745	·3731	·3717	·3701	·3686	·3671	·3656	·3641	·3626	·3611	·3601	·3591
2.7	·3704	·3690	·3676	·3663	·3650	·3636	·3623	·3610	·3600	·3584	·3571	·3556	·3541	·3526	·3511	·3500	·3489	·3474	·3460
2.8	·3571	·3559	·3546	·3534	·3521	·3509	·3497	·3484	·3472	·3459	·3446	·3432	·3418	·3404	·3390	·3378	·3367	·3356	·3344
2.9	·3448	·3436	·3425	·3413	·3401	·3389	·3378	·3367	·3356	·3344	·3333	·3322	·3311	·3300	·3289	·3279	·3268	·3257	·3247
3.0	·3333	·3322	·3311	·3300	·3289	·3279	·3268	·3257	·3247	·3236	·3226	·3215	·3205	·3195	·3185	·3175	·3165	·3155	·3145
3.1	·3226	·3215	·3205	·3195	·3185	·3175	·3165	·3155	·3145	·3135	·3125	·3115	·3106	·3096	·3086	·3077	·3067	·3058	·3049

3.2	·3125	·3115	·3106	·3096	·3086	·3077	·3067	·3058	·3049	·3040	·3030	·3021	·3012	·3003	·2994	·2985	·2976	·2967	·2959
3.3	·3030	·3021	·3012	·2994	·2984	·2975	·2965	·2956	·2947	·2938	·2929	·2919	·2909	·2890	·2880	·2871	·2862	·2853	·2844
3.4	·2941	·2933	·2924	·2915	·2907	·2899	·2890	·2882	·2874	·2865	·2856	·2847	·2838	·2829	·2820	·2811	·2802	·2793	·2786
3.5	·2857	·2849	·2841	·2833	·2825	·2817	·2809	·2801	·2793	·2786	·2778	·2770	·2762	·2754	·2746	·2737	·2729	·2721	·2713
3.6	·2778	·2770	·2762	·2755	·2747	·2740	·2732	·2724	·2717	·2710	·2702	·2694	·2686	·2678	·2670	·2662	·2654	·2646	·2639
3.7	·2703	·2695	·2688	·2681	·2674	·2667	·2660	·2653	·2645	·2638	·2630	·2622	·2614	·2606	·2598	·2590	·2582	·2574	·2566
3.8	·2632	·2625	·2618	·2611	·2604	·2597	·2591	·2584	·2576	·2569	·2561	·2553	·2545	·2537	·2530	·2522	·2514	·2506	·2498
3.9	·2564	·2558	·2551	·2545	·2538	·2532	·2525	·2519	·2513	·2506	·2501	·2494	·2488	·2481	·2475	·2469	·2463	·2457	·2451
4.0	·2500	·2494	·2488	·2481	·2475	·2469	·2463	·2457	·2451	·2445	·2439	·2433	·2427	·2421	·2415	·2410	·2404	·2398	·2392
4.1	·2439	·2433	·2427	·2421	·2415	·2410	·2404	·2400	·2394	·2387	·2381	·2375	·2370	·2364	·2358	·2353	·2347	·2342	·2336
4.2	·2381	·2375	·2370	·2364	·2358	·2353	·2347	·2342	·2336	·2331	·2325	·2319	·2314	·2309	·2304	·2299	·2294	·2288	·2282
4.3	·2326	·2320	·2315	·2310	·2304	·2300	·2295	·2291	·2286	·2281	·2276	·2271	·2266	·2262	·2257	·2252	·2247	·2242	·2237
4.4	·2273	·2268	·2262	·2257	·2252	·2247	·2242	·2237	·2232	·2227	·2221	·2216	·2211	·2206	·2201	·2196	·2193	·2188	·2183
4.5	·2222	·2217	·2212	·2208	·2203	·2198	·2193	·2188	·2183	·2179	·2174	·2169	·2165	·2160	·2155	·2151	·2146	·2141	·2137
4.6	·2174	·2169	·2165	·2160	·2155	·2151	·2146	·2141	·2137	·2132	·2127	·2123	·2119	·2114	·2110	·2105	·2101	·2096	·2092
4.7	·2128	·2123	·2119	·2114	·2110	·2105	·2101	·2096	·2092	·2088	·2084	·2079	·2075	·2070	·2066	·2062	·2058	·2053	·2049
4.8	·2083	·2079	·2075	·2071	·2067	·2063	·2059	·2055	·2051	·2047	·2043	·2039	·2035	·2031	·2027	·2023	·2019	·2015	·2011
4.9	·2041	·2037	·2033	·2028	·2024	·2020	·2016	·2012	·2008	·2004	·2000	·1996	·1992	·1988	·1984	·1980	·1976	·1972	·1969
5.0	·2000	·1996	·1992	·1988	·1984	·1980	·1976	·1972	·1969	·1965	·1961	·1957	·1953	·1949	·1946	·1942	·1938	·1934	·1930
5.1	·1961	·1957	·1953	·1949	·1945	·1941	·1937	·1933	·1929	·1925	·1921	·1917	·1913	·1909	·1905	·1901	·1898	·1894	·1890
5.2	·1923	·1919	·1916	·1912	·1908	·1905	·1901	·1898	·1895	·1891	·1887	·1883	·1880	·1876	·1873	·1869	·1866	·1862	·1859
5.3	·1887	·1883	·1880	·1876	·1873	·1869	·1865	·1862	·1859	·1855	·1851	·1847	·1844	·1841	·1838	·1835	·1832	·1828	·1825
5.4	·1852	·1848	·1845	·1842	·1839	·1836	·1833	·1830	·1827	·1823	·1819	·1816	·1813	·1810	·1807	·1804	·1801	·1798	·1795
0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9	1

RECIPROCALS

SUBTRACT

0	1	2	3	4	5	6	7	8	9
55	·1818	·1815	·1812	·1808	·1805	·1802	·1799	·1795	·1789
56	·1754	·1783	·1779	·1776	·1773	·1770	·1767	·1764	·1761
57	·1724	·1721	·1718	·1715	·1712	·1709	·1706	·1704	·1701
58	·1695	·1692	·1718	·1715	·1712	·1709	·1706	·1704	·1698
59	·1667	·1664	·1661	·1658	·1655	·1653	·1650	·1647	·1645
60	·1639	·1637	·1634	·1631	·1629	·1626	·1623	·1621	·1618
61	·1613	·1610	·1608	·1605	·1603	·1600	·1597	·1595	·1592
62	·1587	·1585	·1582	·1580	·1577	·1575	·1572	·1570	·1567
63	·1563	·1560	·1558	·1555	·1553	·1550	·1548	·1546	·1543
64	·1538	·1536	·1534	·1531	·1529	·1527	·1524	·1522	·1520
65	·1515	·1513	·1511	·1508	·1506	·1504	·1502	·1499	·1497
66	·1493	·1490	·1488	·1486	·1484	·1481	·1479	·1477	·1475
67	·1471	·1468	·1466	·1464	·1462	·1460	·1458	·1456	·1453
68	·1449	·1447	·1445	·1443	·1441	·1439	·1437	·1435	·1433
69	·1429	·1427	·1425	·1422	·1420	·1418	·1416	·1414	·1412
70	·1408	·1406	·1404	·1403	·1401	·1399	·1397	·1395	·1393
71	·1389	·1387	·1385	·1383	·1381	·1379	·1377	·1375	·1374
72	·1370	·1368	·1366	·1364	·1362	·1361	·1359	·1357	·1355
73	·1351	·1350	·1348	·1346	·1344	·1342	·1340	·1339	·1337
74	·1333	·1332	·1330	·1328	·1326	·1325	·1323	·1321	·1319
75	·1316	·1314	·1312	·1311	·1309	·1307	·1305	·1304	·1302
76	·1299	·1295	·1294	·1292	·1290	·1277	·1276	·1274	·1272
77	·1282	·1280	·1279	·1277	·1276	·1274	·1272	·1271	·1270
78	·1266	·1264	·1263	·1261	·1259	·1259	·1258	·1255	·1253
79	·1250	·1248	·1247	·1245	·1244	·1242	·1241	·1239	·1238
80	·1235	·1233	·1232	·1230	·1229	·1227	·1225	·1224	·1222
81	·1220	·1218	·1217	·1215	·1214	·1212	·1211	·1209	·1208
82	·1205	·1203	·1202	·1200	·1199	·1198	·1196	·1195	·1192
83	·1190	·1189	·1188	·1186	·1185	·1183	·1182	·1181	·1178
84	·1176	·1175	·1174	·1172	·1171	·1170	·1168	·1167	·1164
85	·1163	·1161	·1160	·1159	·1157	·1156	·1155	·1153	·1152
86	·1149	·1148	·1147	·1145	·1144	·1143	·1142	·1140	·1139
87	·1136	·1135	·1134	·1133	·1131	·1130	·1129	·1127	·1126
88	·1124	·1122	·1121	·1120	·1119	·1117	·1116	·1115	·1114
89	·1111	·1110	·1109	·1107	·1106	·1105	·1104	·1103	·1101
90	·1099	·1098	·1096	·1095	·1094	·1093	·1092	·1091	·1089
91	·1087	·1086	·1085	·1083	·1082	·1081	·1080	·1079	·1078
92	·1075	·1074	·1073	·1072	·1071	·1070	·1068	·1067	·1066
93	·1064	·1063	·1062	·1060	·1059	·1058	·1057	·1056	·1054
94	·1053	·1052	·1050	·1049	·1048	·1047	·1046	·1045	·1044
95	·1042	·1041	·1040	·1038	·1037	·1036	·1035	·1034	·1033
96	·1031	·1030	·1029	·1028	·1027	·1026	·1025	·1024	·1022
97	·1020	·1019	·1018	·1017	·1016	·1015	·1014	·1013	·1012
98	·1010	·1009	·1008	·1007	·1006	·1005	·1004	·1003	·1002
99	·1000	·999	·998	·997	·996	·995	·994	·993	·992

0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
1	2	3	4	5	6	7	8	9	0
2	3	4	5	6	7	8	9	0	1
3	4	5	6	7	8	9	0	1	2
4	5	6	7	8	9	0	1	2	3
5	6	7	8	9	0	1	2	3	4
6	7	8	9	0	1	2	3	4	5
7	8	9	0	1	2	3	4	5	6
8	9	0	1	2	3	4	5	6	7
9	0	1	2	3	4	5	6	7	8

NAPIERIAN LOGARITHMS

LOG_e N

N	0	1	2	3	4	5	6	7	8	9	9	1	2	3	4	5	6	7	8	9
1.0	0.00000	0.100	0.198	0.296	0.392	0.488	0.583	0.677	0.770	0.862	10.19	29	38.48	57	45.52	58	67.76	86		
1.1	0.0953	1.044	1.133	1.222	1.310	1.398	1.484	1.570	1.655	1.740	9.17	26	35.44	52	61.70	78				
1.2	0.1823	1.906	1.989	2.072	2.151	2.231	2.311	2.390	2.469	2.546	8.16	24	32.40	48	56.64	72				
1.3	0.2624	2.700	2.776	2.852	2.927	3.001	3.075	3.148	3.221	3.293	7.15	22	30.37	44	52.59	67				
1.4	0.3565	3.436	3.507	3.577	3.646	3.716	3.784	3.853	3.920	3.988	7.14	21	28.35	41	48.55	62				
1.5	0.4055	4.121	4.187	4.253	4.318	4.383	4.447	4.511	4.574	4.637	6.13	19	26.32	39	43.52	58				
1.6	0.4700	4.762	4.824	4.886	4.947	5.008	5.068	5.128	5.188	5.247	6.12	18	24.30	36	42.48	55				
1.7	0.5306	5.365	5.423	5.481	5.539	5.596	5.653	5.710	5.766	5.822	6.11	17	23.29	34	40.46	51				
1.8	0.5978	5.933	5.988	6.043	6.098	6.152	6.206	6.260	6.313	6.366	5.11	16	22.27	32	38.43	49				
1.9	0.6619	6.471	6.533	6.575	6.627	6.678	6.729	6.780	6.831	6.881	5.10	15	20.26	31	36.41	46				
2.0	0.6931	6.981	7.031	7.080	7.129	7.178	7.227	7.275	7.324	7.372	5.10	15	20.24	29	34.39	44				
2.1	0.7419	7.467	7.514	7.561	7.608	7.655	7.701	7.747	7.793	7.839	5.9	14	19.23	28	33.37	42				
2.2	0.7885	7.930	7.975	8.020	8.065	8.109	8.154	8.195	8.242	8.286	4.9	13	18.22	27	31.36	40				
2.3	0.8329	8.372	8.416	8.461	8.502	8.544	8.587	8.629	8.671	8.713	4.9	13	17.21	26	29.34	38				
2.4	0.8755	8.796	8.838	8.879	8.920	8.961	9.002	9.042	9.083	9.123	4.8	12	16.20	24	29.33	37				
2.5	0.9163	9.203	9.243	9.282	9.322	9.361	9.400	9.439	9.478	9.517	4	8.12	16.20	24	27.31	35				
2.6	0.9555	9.594	9.632	9.670	9.708	9.746	9.783	9.821	9.858	9.895	4	8.11	15.19	23	26.30	34				
2.7	0.9933	9.969	0.0006	0.043	0.080	0.116	0.152	0.188	0.225	0.260	4	7.11	15.18	22	25.29	33				
2.8	1.0296	0.332	0.367	0.403	0.438	0.473	0.508	0.543	0.578	0.613	4	7.11	14.18	21	25.28	32				
2.9	1.0647	0.682	0.716	0.750	0.784	0.818	0.852	0.886	0.919	0.953	3	7.10	14.17	20	24.27	31				
3.0	1.0986	1.019	1.053	1.086	1.119	1.151	1.184	1.217	1.249	1.282	3	7.10	13.16	20	23.25	30				
3.1	1.1314	1.346	1.378	1.410	1.442	1.474	1.506	1.537	1.569	1.600	3	6.10	13.16	19	22.25	29				
3.2	1.1632	1.663	1.694	1.725	1.756	1.787	1.817	1.848	1.878	1.909	3	6.9	12.15	18	21.25	28				
3.3	1.1939	1.969	2.000	2.030	2.060	2.090	2.119	2.149	2.179	2.208	3	6.9	12.15	18	21.24	27				
3.4	1.2238	2.267	2.296	2.326	2.355	2.384	2.413	2.442	2.470	2.499	3	6.9	12.15	17	20	23	26			

The black type indicates that the integer changes.

N	0	1	2	3	4	5	6	7	8	9	9	1	2	3	4	5	6	7	8	9
3.5	1.2528	2.556	2.585	2.613	2.641	2.669	2.698	2.726	2.754	2.782	3	6	11	14	17	20	22	25		
3.6	1.2809	2.887	2.965	3.020	3.097	3.294	3.297	3.3029	3.3056	3.3056	3	5	8	11	14	16	19	22	25	
3.7	1.3083	3.110	3.137	3.164	3.191	3.218	3.244	3.271	3.297	3.327	3	5	8	10	13	16	19	21	23	
3.8	1.3350	3.376	3.403	3.429	3.455	3.481	3.507	3.533	3.558	3.584	3	5	8	10	13	15	18	20	23	
3.9	1.3610	3.635	3.661	3.686	3.712	3.737	3.762	3.788	3.813	3.838	3	5	8	10	13	15	18	20	23	
4.0	1.3863	3.888	3.913	3.938	3.962	3.987	4.012	4.036	4.061	4.085	2	5	7	10	12	15	17	20	22	
4.1	1.4110	4.134	4.159	4.183	4.207	4.231	4.255	4.279	4.303	4.327	2	5	7	10	12	14	17	19	22	
4.2	1.4351	4.375	4.398	4.422	4.446	4.469	4.493	4.516	4.540	4.563	2	5	7	9	12	14	16	18	21	
4.3	1.4586	4.609	4.633	4.656	4.679	4.703	4.725	4.748	4.770	4.793	2	5	7	9	11	14	16	18	20	
4.4	1.4816	4.839	4.861	4.884	4.907	4.929	4.951	4.974	4.996	5.019	2	5	7	9	11	14	16	18	20	
4.5	1.5041	5.063	5.085	5.107	5.129	5.151	5.173	5.195	5.217	5.239	2	4	7	9	11	13	15	18	20	
4.6	1.5261	5.282	5.304	5.326	5.347	5.369	5.390	5.412	5.433	5.454	2	4	6	8	10	12	14	16	18	
4.7	1.5476	5.497	5.518	5.539	5.560	5.581	5.602	5.623	5.644	5.665	2	4	6	8	10	12	14	16	19	
4.8	1.5686	5.707	5.728	5.748	5.769	5.790	5.810	5.831	5.851	5.872	2	4	6	8	10	12	14	16	19	
4.9	1.5892	5.913	5.933	5.953	5.974	5.994	6.014	6.034	6.054	6.074	2	4	6	8	10	12	14	16	18	
5.0	1.6094	6.114	6.134	6.154	6.174	6.194	6.214	6.233	6.253	6.273	2	4	6	8	10	12	14	16	18	
5.1	1.6292	6.312	6.332	6.351	6.371	6.390	6.409	6.429	6.448	6.467	2	4	6	8	10	12	14	16	18	
5.2	1.6487	6.506	6.525	6.544	6.563	6.582	6.601	6.620	6.639	6.658	2	4	6	8	10	11	13	15	17	
5.3	1.6677	6.696	6.715	6.734	6.752	6.771	6.790	6.808	6.827	6.845	2	4	6	7	9	11	13	15	17	
5.4	1.6864	6.882	6.901	6.919	6.938	6.956	6.974	6.993	7.011	7.029	2	4	5	7	9	11	13	15	16	

N	0	1	2	3	4	5	6	7	8	9	9	1	2	3	4	5	6	7	8	9
log _e 10 ^x	2.3026	4.6052	6.9078	9.2103	11.5129	13.8155														

For further values, e.g. log_e 4560, write 4560 = 4.560 × 10³ and use the table below.

NAPIERIAN LOGARITHMS

LOG._N

N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
5.5	1.7047	7066	7084	7102	7120	7138	7156	7174	7192	7210	2	4	5	7	9	11	13	14	16
5.6	1.7228	7246	7263	7281	7299	7317	7334	7352	7370	7387	2	4	5	7	9	11	12	14	16
5.7	1.7405	7422	7440	7457	7475	7492	7509	7527	7544	7561	2	3	5	7	9	10	12	14	16
5.8	1.7579	7596	7613	7630	7647	7664	7681	7699	7716	7733	2	3	5	7	9	10	12	14	16
5.9	1.7750	7766	7783	7800	7817	7834	7851	7867	7884	7901	2	3	5	7	8	10	12	13	15
6.0	1.7918	7934	7951	7967	7984	8001	8017	8034	8050	8066	2	3	5	7	8	10	12	13	15
6.1	1.8083	8099	8116	8132	8148	8165	8181	8197	8213	8229	2	3	5	6	8	10	11	13	15
6.2	1.8245	8262	8278	8294	8310	8326	8342	8358	8374	8390	2	3	5	6	8	10	11	13	14
6.3	1.8405	8421	8437	8453	8469	8485	8500	8516	8532	8547	2	3	5	6	8	9	11	13	14
6.4	1.8563	8579	8594	8610	8625	8641	8656	8672	8687	8703	2	3	5	6	8	9	11	12	14
6.5	1.8718	8733	8749	8764	8779	8795	8810	8825	8840	8856	2	3	5	6	8	9	11	12	14
6.6	1.8871	8886	8901	8916	8931	8946	8961	8976	8991	9006	2	3	5	6	8	9	11	12	14
6.7	1.9021	9036	9051	9066	9081	9095	9110	9125	9140	9155	1	3	4	6	7	9	10	12	13
6.8	1.9169	9184	9199	9213	9228	9242	9257	9272	9286	9301	1	3	4	6	7	9	10	12	13
6.9	1.9315	9330	9344	9359	9373	9387	9402	9416	9430	9445	1	3	4	6	7	9	10	12	13
7.0	1.9459	9473	9488	9502	9516	9530	9544	9559	9573	9587	1	3	4	6	7	9	10	11	13
7.1	1.9601	9615	9629	9643	9657	9671	9685	9699	9713	9727	1	3	4	6	7	8	10	11	13
7.2	1.9741	9755	9769	9782	9796	9810	9824	9838	9851	9865	1	3	4	6	7	8	10	11	12
7.3	1.9879	9892	9906	9920	9933	9947	9961	9974	9988	9998	0	0	0	5	7	8	9	11	12
7.4	2.0015	0028	0042	0055	0069	0082	0096	0109	0122	0136	1	3	4	5	7	8	9	11	12
7.5	2.0149	0162	0176	0189	0202	0215	0229	0242	0255	0268	1	3	4	5	7	8	9	11	12
7.6	2.0281	0295	0308	0321	0334	0347	0360	0373	0386	0399	1	3	4	5	7	8	9	10	12
7.7	2.0412	0425	0438	0451	0464	0477	0490	0503	0516	0528	1	3	4	5	6	8	9	10	12
7.8	2.0541	0554	0567	0580	0592	0605	0618	0631	0643	0656	1	3	4	5	6	8	9	10	12
7.9	2.0669	0681	0694	0707	0719	0732	0744	0757	0769	0782	1	3	4	5	6	8	9	10	11

The black type indicates that the integer changes.

N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
8.0	2.0794	0807	0819	0832	0844	0857	0869	0882	0894	0906	1	3	4	5	6	8	9	10	11
8.1	2.0919	0931	0943	0956	0968	0980	1000	1017	1029	1041	1	2	4	5	6	7	9	10	11
8.2	2.1041	1054	1066	1078	1090	1102	1114	1126	1138	1150	1	2	4	5	6	7	8	10	11
8.3	2.1163	1175	1187	1199	1211	1223	1235	1247	1258	1270	1	2	4	5	6	7	8	10	11
8.4	2.1282	1294	1306	1318	1330	1342	1353	1365	1377	1389	1	2	4	5	6	7	8	10	11
8.5	2.1401	1412	1424	1436	1448	1459	1471	1483	1494	1506	1	2	4	5	6	7	8	9	11
8.6	2.1518	1529	1541	1552	1564	1576	1587	1599	1610	1622	1	2	3	5	6	7	8	9	10
8.7	2.1633	1645	1656	1668	1679	1691	1702	1713	1725	1736	1	2	3	5	6	7	8	9	10
8.8	2.1748	1759	1770	1782	1793	1804	1815	1827	1838	1849	1	2	3	5	6	7	8	9	10
8.9	2.1861	1872	1883	1894	1905	1917	1928	1939	1950	1961	1	2	3	4	6	7	8	9	10
9.0	2.1972	1983	1994	2006	2017	2028	2039	2050	2061	2072	1	2	3	4	6	7	8	9	10
9.1	2.2083	2094	2105	2116	2127	2138	2148	2159	2170	2181	1	2	3	4	5	6	7	8	9
9.2	2.2192	2203	2214	2225	2235	2246	2257	2268	2279	2289	1	2	3	4	5	6	7	8	9
9.3	2.2300	2311	2322	2332	2343	2354	2364	2375	2386	2396	1	2	3	4	5	6	7	9	10
9.4	2.2407	2418	2428	2439	2450	2460	2471	2481	2492	2502	1	2	3	4	5	6	7	9	10
9.5	2.2513	2523	2534	2544	2555	2565	2576	2586	2597	2607	1	2	3	4	5	6	7	8	9
9.6	2.2618	2628	2638	2649	2659	2670	2680	2690	2701	2711	1	2	3	4	5	6	7	8	9
9.7	2.2721	2732	2742	2752	2762	2773	2783	2793	2803	2814	1	2	3	4	5	6	7	8	9
9.8	2.2824	2834	2844	2854	2865	2875	2885	2895	2905	2915	1	2	3	4	5	6	7	8	9
9.9	2.2925	2935	2946	2956	2966	2976	2986	2996	3006	3016	1	2	3	4	5	6	7	8	9

N	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
log ₁₀ -#	3.6974	5.3948	7.0922	10.7897	12.4871	14.1845													

x	-00	-01	-02	-03	-04	-05	-06	-07	-08	-09
0.0	1.0000	1.0101	1.0202	1.0305	1.0408	1.0513	1.0618	1.0725	1.0833	1.0942
0.1	1.1052	1.1163	1.1275	1.1388	1.1503	1.1618	1.1735	1.1855	1.1975	1.2092
0.2	1.2214	1.2337	1.2461	1.2586	1.2712	1.2840	1.2969	1.3100	1.3331	1.3564
0.3	1.3499	1.3634	1.3771	1.3910	1.4049	1.4191	1.4333	1.4477	1.4623	1.4770
0.4	1.4918	1.5068	1.5220	1.5373	1.5527	1.5683	1.5841	1.6000	1.6161	1.6323
0.5	1.6487	1.6653	1.6820	1.6989	1.7160	1.7333	1.7507	1.7683	1.7860	1.8040
0.6	1.8221	1.8404	1.8589	1.8776	1.8965	1.9155	1.9348	1.9542	1.9747	1.9957
0.7	2.0138	2.0440	2.0544	2.0751	2.0959	2.1170	2.1383	2.1598	2.1815	2.2034
0.8	2.2255	2.2479	2.2705	2.2933	2.3164	2.3396	2.3632	2.3869	2.4109	2.4351
0.9	2.4596	2.4843	2.5093	2.5343	2.5600	2.5857	2.6117	2.6379	2.6645	2.6912
1.0	2.7183	2.7456	2.7732	2.8011	2.8292	2.8576	2.8864	2.9154	2.9447	2.9743
1.1	3.0042	3.0444	3.0849	3.0975	3.1268	3.1552	3.1899	3.2220	3.2544	3.2871
1.2	3.3201	3.3535	3.3870	3.4212	3.4556	3.4903	3.5254	3.5608	3.5966	3.6328
1.3	3.6693	3.7062	3.7434	3.7810	3.8190	3.8574	3.8962	3.9354	3.9749	4.0149
1.4	4.0552	4.0960	4.1371	4.1787	4.2207	4.2631	4.3060	4.3492	4.3929	4.4371
1.5	4.4817	4.5267	4.5722	4.6182	4.6646	4.7115	4.7588	4.8066	4.8550	4.9037
1.6	4.9550	5.0028	5.0531	5.1039	5.1552	5.2070	5.2593	5.3122	5.3656	5.4195
1.7	5.4739	5.5290	5.5845	5.6407	5.6973	5.7546	5.8124	5.8709	5.9299	5.9895
1.8	6.0496	6.1104	6.1719	6.2339	6.2965	6.3598	6.4237	6.4883	6.5535	6.6194
1.9	6.6859	6.7531	6.8210	6.8895	6.9588	7.0287	7.0993	7.1707	7.2427	7.3155
2.0	7.3891	7.4633	7.5383	7.6141	7.6906	7.7679	7.8460	7.9248	8.0045	8.0849
2.1	8.1662	8.2482	8.3311	8.4149	8.4994	8.5849	8.6711	8.7583	8.8463	8.9323
2.2	9.0250	9.1157	9.2073	9.2999	9.3933	9.4877	9.5831	9.6794	9.7767	9.8749
2.3	9.9742	10.074	10.176	10.278	10.381	10.486	10.591	10.697	10.805	10.913
2.4	11.023	11.134	11.246	11.359	11.473	11.588	11.705	11.822	11.941	12.061

x	-00	-01	-02	-03	-04	-05	-06	-07	-08	-09
2.5	12.182	12.305	12.429	12.554	12.680	12.807	12.936	13.066	13.197	13.330
2.6	13.464	13.599	13.736	13.874	14.013	14.154	14.296	14.440	14.585	14.732
2.7	14.880	15.029	15.180	15.333	15.487	15.643	15.800	15.959	16.119	16.281
2.8	16.445	16.610	16.777	16.945	17.116	17.288	17.462	17.637	17.814	17.993
2.9	18.174	18.357	18.541	18.728	18.916	19.106	19.298	19.492	19.688	19.886
3.0	20.086	20.287	20.491	20.697	20.905	21.115	21.327	21.542	21.758	21.977
3.1	22.198	22.421	22.646	22.874	23.104	23.336	23.571	23.808	24.047	24.288
3.2	24.533	24.779	25.028	25.280	25.534	25.790	26.050	26.311	26.576	26.843
3.3	27.113	27.385	27.660	27.938	28.219	28.503	28.789	29.079	29.371	29.666
3.4	29.964	30.263	30.569	30.877	31.187	31.500	31.817	32.137	32.460	32.786
3.5	33.115	33.448	33.784	34.124	34.467	34.813	35.163	35.517	35.874	36.234
3.6	36.598	36.966	37.338	37.713	38.092	38.475	38.861	39.252	39.646	40.045
3.7	40.447	40.854	41.264	41.679	42.098	42.521	42.948	43.380	43.816	44.256
3.8	44.701	45.150	45.604	46.063	46.525	46.993	47.465	47.942	48.424	48.911
3.9	49.402	49.899	50.400	50.907	51.419	51.935	52.457	52.985	53.517	54.055
4.0	54.598									
	-00	-01	-02	-03	-04	-05	-06	-07	-08	-09

x	e^x	$x$	$e^x$	$x$	$e^x$	$x$	$e^x$	$x$	$e^x$	$x$	$e^x$
4.1	60.340	4.6	99.484	5.1	164.02	5.6	270.43	6.1	445.86	6.6	735.10
4.2	66.686	4.7	109.95	5.2	181.27	5.7	298.87	6.2	492.75	6.7	812.41
4.3	73.700	4.8	121.51	5.3	200.34	5.8	330.30	6.3	544.57	6.8	992.85
4.4	81.451	4.9	134.29	5.4	221.41	5.9	365.04	6.4	601.85	6.9	992.27
4.5	90.017	5.0	148.41	5.5	244.69	6.0	403.43	6.5	665.14	7.0	1096.63

For further values use $\log_e e^x = 0.4342945 \times x$; or use Napierian logarithms, see foot of p. 69.

x	•00	•01	•02	•03	•04	•05	•06	•07	•08	•09
0.0	1.0000	.9900	.9802	.9704	.9608	.9512	.9418	.9324	.9231	.9139
0.1	.99048	.8958	.8869	.8781	.8694	.8607	.8521	.8437	.8353	.8270
0.2	.88187	.8106	.8025	.7945	.7866	.7788	.7711	.7634	.7558	.7483
0.3	.74408	.7334	.7261	.7189	.7118	.7047	.6977	.6907	.6839	.6771
0.4	.67073	.6637	.6570	.6505	.6440	.6376	.6313	.6250	.6188	.6126
0.5	.60605	.6005	.5945	.5886	.5827	.5769	.5712	.5655	.5599	.5543
0.6	.54888	.5434	.5379	.5326	.5273	.5220	.5169	.5117	.5066	.5016
0.7	.49668	.4916	.4868	.4819	.4771	.4724	.4677	.4630	.4584	.4533
0.8	.44963	.4449	.4404	.4360	.4317	.4274	.4232	.4190	.4148	.4107
0.9	.40666	.4025	.3985	.3946	.3906	.3867	.3829	.3791	.3753	.3716
1.0	.36379	.3642	.3606	.3570	.3535	.3499	.3465	.3430	.3396	.3362
1.1	.33329	.3296	.3263	.3220	.3198	.3166	.3135	.3104	.3073	.3042
1.2	.30112	.2982	.2952	.2923	.2894	.2863	.2837	.2808	.2780	.2753
1.3	.2725	.2698	.2671	.2645	.2618	.2592	.2567	.2541	.2516	.2491
1.4	.24466	.2441	.2417	.2393	.2369	.2346	.2322	.2299	.2276	.2254
1.5	.2231	.2209	.2187	.2165	.2144	.2122	.2101	.2080	.2060	.2039
1.6	.202019	.1999	.1979	.1959	.1940	.1920	.1901	.1882	.1864	.1845
1.7	.18227	.1809	.1791	.1773	.1755	.1738	.1720	.1703	.1686	.1670
1.8	.16533	.1637	.1620	.1604	.1588	.1572	.1557	.1541	.1526	.1511
1.9	.1496	.1481	.1466	.1451	.1437	.1423	.1409	.1395	.1381	.1367
2.0	.13533	.1340	.1327	.1313	.1300	.1287	.1275	.1262	.1249	.1237
2.1	.12225	.1212	.1200	.1188	.1177	.1165	.1153	.1142	.1130	.1119
2.2	.11108	.1097	.1085	.1075	.1065	.1054	.1044	.1033	.1023	.1013
2.3	.10003	.0993	.0983	.0973	.0963	.0954	.0944	.0935	.0925	.0916
2.4	.09097	.0898	.0889	.0872	.0863	.0854	.0846	.0837	.0829	

x	•00	•01	•02	•03	•04	•05	•06	•07	•08	•09
2.5	.0813	.0805	.0797	.0789	.0781	.0773	.0765	.0758	.0750	
2.6	.0743	.0735	.0728	.0721	.0714	.0707	.0699	.0693	.0686	
2.7	.0672	.0665	.0659	.0652	.0646	.0639	.0633	.0627	.0620	
2.8	.0608	.0602	.0596	.0590	.0584	.0578	.0573	.0567	.0561	
2.9	.0550	.0545	.0539	.0534	.0529	.0523	.0518	.0513	.0508	
3.0	.0498	.0493	.0488	.0483	.0478	.0474	.0469	.0464	.0460	
3.1	.0450	.0446	.0442	.0437	.0433	.0429	.0424	.0420	.0416	
3.2	.0408	.0404	.0400	.0396	.0392	.0388	.0384	.0380	.0376	
3.3	.0369	.0365	.0362	.0358	.0354	.0351	.0347	.0344	.0340	
3.4	.0334	.0330	.0327	.0324	.0321	.0317	.0314	.0311	.0308	
3.5	.0302	.0299	.0296	.0293	.0290	.0287	.0284	.0282	.0279	
3.6	.0273	.0271	.0268	.0265	.0263	.0260	.0257	.0255	.0252	
3.7	.0247	.0245	.0242	.0240	.0238	.0235	.0233	.0231	.0228	
3.8	.0224	.0221	.0219	.0217	.0215	.0213	.0211	.0209	.0207	
3.9	.0202	.0200	.0198	.0196	.0194	.0193	.0191	.0189	.0187	
4.0	.0183									

e^{-x} may be found from the e^x table and the reciprocal table.

$$y = e^{x+0.0054}, \log y = 3.9054$$

$$\log 10 = 2.3026$$

$$\log 4.967 = 1.6028$$

$$\therefore y = 49.67$$

$$y = e^{34.2164}, \log y = 24.764$$

$$2 \log 10 = 23.0258$$

$$\log 3.492 = 1.2506$$

$$\therefore y = 10^{\circ} \times 3.492$$

sinh α

α	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	0.0000	0.0100	0.0200	0.0300	0.0400	0.0500	0.0600	0.0701	0.0801	0.0901
0.1	0.1102	0.1203	0.1304	0.1405	0.1506	0.1607	0.1708	0.1810	0.1911	0.2011
0.2	0.2013	0.2115	0.2218	0.2320	0.2423	0.2526	0.2629	0.2733	0.2837	0.2941
0.3	0.3045	0.3150	0.3255	0.3360	0.3466	0.3572	0.3678	0.3785	0.3892	0.4000
0.4	0.4108	0.4216	0.4325	0.4434	0.4543	0.4653	0.4764	0.4875	0.4986	0.5098
0.5	0.5211	0.5324	0.5438	0.5552	0.5666	0.5782	0.5897	0.6014	0.6131	0.6248
0.6	0.6367	0.6485	0.6605	0.6725	0.6846	0.6967	0.7090	0.7213	0.7336	0.7461
0.7	0.7586	0.7712	0.7838	0.7966	0.8094	0.8223	0.8353	0.8484	0.8615	0.8748
0.8	0.8881	0.9015	0.9150	0.9286	0.9423	0.9561	0.9700	0.9840	0.9981	0.0122
0.9	1.0265	1.0409	1.0554	1.0700	1.0847	1.0995	1.1144	1.1294	1.1446	1.1598
1.0	1.1752	1.1907	1.2063	1.2220	1.2379	1.2539	1.2700	1.2862	1.3025	1.3190
1.1	1.3356	1.3524	1.3693	1.3863	1.4035	1.4208	1.4382	1.4558	1.4735	1.4914
1.2	1.5095	1.5276	1.5460	1.5645	1.5831	1.6019	1.6209	1.6400	1.6593	1.6788
1.3	1.6984	1.7182	1.7381	1.7583	1.7786	1.7991	1.8198	1.8406	1.8617	1.8829
1.4	1.9043	1.9239	1.9477	1.9697	1.9919	2.0143	2.0369	2.0597	2.0827	2.1059
1.5	2.1293	2.1529	2.1768	2.2008	2.2251	2.2496	2.2743	2.2993	2.3245	2.3499
1.6	2.3756	2.4015	2.4276	2.4540	2.4806	2.5075	2.5346	2.5620	2.5896	2.6175
1.7	2.6456	2.6740	2.7027	2.7317	2.7609	2.7904	2.8202	2.8503	2.8806	2.9112
1.8	2.9422	2.9734	3.0049	3.0367	3.0689	3.1013	3.1340	3.1671	3.2005	3.2341
1.9	3.2682	3.3025	3.3372	3.3722	3.4075	3.4432	3.4792	3.5156	3.5523	3.5894

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α	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
2.0	3.6269	3.6647	3.7028	3.7413	3.7803	3.8196	3.8593	3.8993	3.9398	3.9806
2.1	4.0219	4.0635	4.1056	4.1480	4.1909	4.2342	4.2779	4.3221	4.3666	4.4116
2.2	4.4571	4.5030	4.5594	4.5962	4.6434	4.6913	4.7394	4.7881	4.8372	4.8868
2.3	4.9370	5.0387	5.1087	5.1797	5.2503	5.3283	5.4020	5.4862	5.5410	5.6109
2.4	5.4662	5.5221	5.5785	5.6354	5.6929	5.7510	5.8097	5.8689	5.9288	5.9892
2.5	6.0502	6.1118	6.1741	6.2369	6.3004	6.3645	6.4293	6.4946	6.5607	6.6274
2.6	6.7628	6.8315	6.9008	6.9709	7.0417	7.1132	7.1854	7.2583	7.3319	7.4033
2.7	7.4063	7.4814	7.5572	7.6338	7.7112	7.7894	7.8632	7.9480	8.0285	8.1098
2.8	8.1919	8.2749	8.3586	8.4432	8.5287	8.6150	8.7021	8.7902	8.8791	8.9689
2.9	9.0596	9.1512	9.2437	9.3371	9.4315	9.5268	9.6231	9.7203	9.8185	9.9177
3.0	10.0118	10.1119	10.221	10.324	10.429	10.534	10.640	10.748	10.856	10.966
3.1	11.076	11.188	11.301	11.415	11.530	11.647	11.764	11.883	12.003	12.124
3.2	12.246	12.369	12.494	12.620	12.747	12.876	13.006	13.137	13.269	13.403
3.3	13.538	13.674	13.812	13.951	14.092	14.234	14.377	14.522	14.668	14.816
3.4	14.965	15.116	15.268	15.422	15.577	15.734	15.893	16.053	16.214	16.378
3.5	16.543	16.709	16.877	17.047	17.219	17.392	17.567	17.744	17.923	18.103
3.6	18.285	18.470	18.655	18.843	19.033	19.224	19.418	19.613	19.811	20.010
3.7	20.211	20.415	20.620	20.828	21.037	21.249	21.463	21.679	21.897	22.117
3.8	22.339	22.564	22.791	23.020	23.252	23.486	23.722	23.961	24.202	24.445
3.9	24.691	24.939	25.190	25.444	25.700	25.958	26.219	26.483	26.749	27.018
4.0	27.290									
	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09

For further values use $\sinh x = \frac{1}{2}(e^x - e^{-x})$.

71

cosh x

x	·00	·01	·02	·03	·04	·05	·06	·07	·08	·09
0·0	1·0000	1·0002	1·0005	1·0008	1·0013	1·0018	1·0025	1·0032	1·0041	
0·1	1·0050	1·0061	1·0072	1·0085	1·0098	1·0113	1·0128	1·0145	1·0162	1·0181
0·2	1·0201	1·0221	1·0243	1·0266	1·0289	1·0314	1·0340	1·0367	1·0395	1·0423
0·3	1·0453	1·0484	1·0516	1·0549	1·0584	1·0619	1·0655	1·0692	1·0731	1·0770
0·4	1·0811	1·0852	1·0895	1·0939	1·0984	1·1030	1·1077	1·1125	1·1174	1·1225
0·5	1·1276	1·1329	1·1383	1·1438	1·1494	1·1551	1·1609	1·1669	1·1730	1·1792
0·6	1·1855	1·1919	1·1984	1·2051	1·2119	1·2188	1·2258	1·2330	1·2402	1·2476
0·7	1·2552	1·2625	1·2706	1·2785	1·2865	1·2947	1·3030	1·3114	1·3199	1·3286
0·8	1·3374	1·3464	1·3555	1·3647	1·3740	1·3835	1·3932	1·4029	1·4128	1·4229
0·9	1·4331	1·4434	1·4539	1·4645	1·4753	1·4862	1·4973	1·5085	1·5199	1·5314
1·0	1·5431	1·5549	1·5669	1·5790	1·5913	1·6038	1·6164	1·6292	1·6421	1·6552
1·1	1·6685	1·6820	1·6956	1·7093	1·7233	1·7374	1·7515	1·7662	1·7808	1·7957
1·2	1·8107	1·8258	1·8412	1·8568	1·8725	1·8884	1·9045	1·9208	1·9373	1·9540
1·3	1·9709	1·9880	2·0053	2·0228	2·0404	2·0583	2·0764	2·0947	2·1132	2·1320
1·4	2·1509	2·1700	2·1894	2·2090	2·2288	2·2488	2·2691	2·2896	2·3103	2·3312
1·5	2·3524	2·3738	2·3955	2·4174	2·4395	2·4619	2·4845	2·5073	2·5305	2·5538
1·6	2·5775	2·6014	2·6255	2·6499	2·6746	2·6995	2·7247	2·7502	2·7760	2·8020
1·7	2·8283	2·8549	2·8818	2·9090	2·9364	2·9642	2·9922	3·0206	3·0492	3·0782
1·8	3·1075	3·1371	3·1669	3·1971	3·2277	3·2585	3·2897	3·3212	3·3530	3·3832
1·9	3·4306	3·4506	3·4838	3·5173	3·5512	3·5855	3·6201	3·6551	3·6904	3·7261

x	·00	·01	·02	·03	·04	·05	·06	·07	·08	·09
2·0	3·7622	3·7987	3·8355	3·8727	3·9103	3·9483	3·9867	4·0255	4·0647	4·1043
2·1	4·1443	4·1847	4·2256	4·2669	4·3085	4·3507	4·3932	4·4362	4·4797	4·5236
2·2	4·5679	4·6127	4·6580	4·7037	4·7499	4·7966	4·8437	4·8914	4·9395	4·9881
2·3	5·0372	5·0868	5·1370	5·1876	5·2388	5·2905	5·3427	5·3954	5·4487	5·5026
2·4	5·5569	5·6119	5·6674	5·7235	5·7801	5·8373	5·8951	5·9535	6·0125	6·0721
2·5	6·1323	6·1931	6·2546	6·3166	6·3793	6·4426	6·5066	6·5712	6·6365	6·7024
2·6	6·7690	6·8363	6·9043	6·9729	7·0423	7·1123	7·1831	7·2546	7·3268	7·3988
2·7	7·4735	7·5479	7·6231	7·6991	7·7758	7·8533	7·9316	8·0106	8·0905	8·1712
2·8	8·2527	8·3351	8·4182	8·5022	8·5871	8·6728	8·7594	8·8469	8·9352	9·0244
2·9	9·1146	9·2056	9·2976	9·3905	9·4844	9·5791	9·6749	9·7716	9·8693	9·9680
3·0	10·068	10·168	10·270	10·373	10·477	10·581	10·687	10·794	10·902	11·011
3·1	11·122	11·233	11·345	11·459	11·574	11·689	11·807	11·925	12·044	12·165
3·2	12·287	12·410	12·534	12·660	12·786	12·915	13·044	13·175	13·307	13·440
3·3	13·575	13·711	13·848	13·987	14·127	14·269	14·412	14·556	14·702	14·850
3·4	14·999	15·149	15·301	15·455	15·610	15·766	15·924	16·084	16·245	16·408
3·5	16·573	16·739	16·907	17·077	17·248	17·421	17·596	17·772	17·951	18·131
3·6	18·313	18·497	18·682	18·870	19·059	19·250	19·444	19·639	19·836	20·035
3·7	20·236	20·439	20·644	20·852	21·061	21·272	21·486	21·702	21·919	22·139
3·8	22·362	22·586	22·813	23·042	23·273	23·507	23·743	23·982	24·222	24·466
3·9	24·711	24·959	25·210	25·463	25·719	25·977	26·238	26·502	26·768	27·037
4·0	27·308									

For further values use $\cosh x = \frac{1}{2}(e^x + e^{-x})$.

SQUARES. FROM 1 TO 10

0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
1.0	1.0000	1.0201	1.0404	1.0609	1.0816	1.1025	1.1236	1.1449	1.1664	1.1881	1.2100	1.2321	1.2544	1.2769	1.2996	1.3225	1.3456	1.3689
1.1	1.2100	1.2321	1.2544	1.2769	1.2996	1.3225	1.3456	1.3689	1.3924	1.4161	1.4400	1.4641	1.4884	1.5129	1.5376	1.5625	1.5876	1.6129
1.2	1.4400	1.4641	1.4884	1.5129	1.5376	1.5625	1.5876	1.6129	1.6384	1.6641	1.6900	1.7161	1.7424	1.7689	1.7954	1.8225	1.8496	1.8769
1.3	1.6900	1.7161	1.7424	1.7689	1.7954	1.8225	1.8496	1.8769	1.9044	1.9321	1.9600	1.9861	2.0124	2.0386	2.0649	2.0916	2.1183	2.1459
1.4	1.9600	1.9861	2.0124	2.0386	2.0649	2.0916	2.1183	2.1459	2.1669	2.1904	2.2201	2.2473	2.2746	2.3024	2.3301	2.3578	2.3856	2.4134
1.5	2.2300	2.2681	2.3061	2.3409	2.3716	2.4025	2.4336	2.4649	2.4964	2.5281	2.5601	2.5921	2.6241	2.6561	2.6881	2.7202	2.7521	2.7841
1.6	2.5600	2.6244	2.6896	2.7225	2.7556	2.7889	2.8224	2.8561	2.8899	2.9234	2.9571	2.9914	3.0256	3.0597	3.0939	3.1279	3.1620	3.1961
1.7	2.8900	2.9241	2.9584	2.9926	3.0225	3.0625	3.0967	3.1309	3.1651	3.2004	3.2354	3.2704	3.3056	3.3408	3.3760	3.4112	3.4464	3.4816
1.8	3.2400	3.2761	3.3124	3.3489	3.3856	3.4225	3.4596	3.4969	3.5344	3.5721	3.6109	3.6504	3.6909	3.7304	3.7699	3.8094	3.8489	3.8884
1.9	3.6100	3.6481	3.6854	3.7249	3.7636	3.8023	3.8416	3.8809	3.9204	3.9601	4.0001	4.0401	4.0804	4.1209	4.1616	4.2025	4.2436	4.2849
2.0	4.0000	4.0401	4.0804	4.1209	4.1616	4.2025	4.2436	4.2849	4.3264	4.3681	4.4100	4.4521	4.4944	4.5368	4.5791	4.6216	4.6640	4.7064
2.1	4.4100	4.4521	4.4944	4.5368	4.5791	4.6216	4.6640	4.7064	4.7489	4.7916	4.8335	4.8756	4.9177	4.9598	4.9999	5.0420	5.0841	5.1262
2.2	4.8400	4.8841	4.9284	4.9729	5.0176	5.0625	5.1076	5.1529	5.1984	5.2441	5.2901	5.3360	5.3824	5.4289	5.4756	5.5225	5.5692	5.6159
2.3	5.2900	5.3361	5.3824	5.4289	5.4756	5.5225	5.5692	5.6159	5.6644	5.7121	5.7601	5.8081	5.8561	5.9049	5.9536	6.0025	6.0516	6.1009
2.4	5.7600	5.8081	5.8561	5.9049	5.9536	6.0025	6.0516	6.1009	6.1504	6.2001	6.2500	6.3001	6.3504	6.4009	6.4516	6.5025	6.5536	6.6049
2.5	6.2500	6.3001	6.3504	6.4009	6.4516	6.5025	6.5536	6.6049	6.6564	6.7081	6.7601	6.8121	6.8644	6.9169	6.9696	7.0225	7.0756	7.1289
2.6	6.7600	7.2500	7.3441	7.3984	7.4529	7.5076	7.5623	7.6176	7.6729	7.7284	7.7837	7.8381	7.8926	7.9470	7.9954	8.0456	8.0959	8.1463
2.7	7.2500	7.3441	7.3984	7.4529	7.5076	7.5623	7.6176	7.6729	7.7284	7.7837	7.8381	7.8926	7.9470	7.9954	8.0456	8.0959	8.1463	8.1967
2.8	7.8400	7.8961	7.9534	8.0056	8.0656	8.1225	8.1796	8.2369	8.2944	8.3521	8.4100	8.4681	8.5264	8.5849	8.6436	8.7025	8.7616	8.8209
2.9	8.4100	8.4681	8.5264	8.5849	8.6436	8.7025	8.7616	8.8209	8.8804	8.9401	9.0000	9.0601	9.1204	9.1809	9.2416	9.3025	9.3636	9.4249
3.0	9.0000	9.0601	9.1204	9.1809	9.2416	9.3025	9.3636	9.4249	9.4864	9.5481	9.6000	9.6601	9.7204	9.7809	9.8396	9.9225	10.0489	10.1724
3.1	9.6100	9.6721	9.7344	9.7969	9.8596	9.9225	9.9856	10.0489	10.1124	10.1764	10.2400	10.3034	10.3656	10.4277	10.4890	10.5512	10.6134	10.6756

0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
3.2	10.240	10.304	10.368	10.433	10.498	10.563	10.628	10.693	10.758	10.824	10.889	10.953	11.018	11.083	11.148	11.213	11.278	11.343
3.3	10.890	10.956	11.022	11.089	11.156	11.223	11.289	11.354	11.420	11.486	11.552	11.618	11.684	11.750	11.816	11.882	11.948	12.014
3.4	11.560	11.628	11.696	11.763	11.834	11.903	11.972	12.041	12.110	12.180	12.250	12.319	12.388	12.457	12.526	12.595	12.664	12.733
3.5	12.250	12.320	12.390	12.461	12.532	12.603	12.674	12.745	12.816	12.888	12.959	13.030	13.101	13.172	13.243	13.314	13.385	13.456
3.6	12.960	13.032	13.104	13.177	13.249	13.320	13.392	13.464	13.535	13.606	13.677	13.748	13.819	13.890	13.961	14.032	14.103	14.174
3.7	13.690	13.764	13.838	13.913	13.988	14.063	14.138	14.213	14.288	14.364	14.440	14.515	14.590	14.665	14.740	14.815	14.890	14.965
3.8	14.440	14.516	14.592	14.668	14.744	14.823	14.900	14.976	15.052	15.130	15.206	15.282	15.358	15.434	15.510	15.586	15.662	15.738
3.9	15.210	15.288	15.366	15.443	15.524	15.603	15.682	15.761	15.840	15.920	16.000	16.079	16.158	16.237	16.316	16.395	16.474	16.553
4.0	16.000	16.080	16.160	16.241	16.322	16.403	16.484	16.565	16.646	16.728	16.810	16.891	16.972	17.053	17.134	17.215	17.296	17.377
4.1	16.810	16.892	16.974	17.057	17.140	17.223	17.306	17.389	17.472	17.555	17.638	17.721	17.804	17.887	17.970	18.053	18.136	18.219
4.2	17.640	17.724	17.808	17.893	17.978	18.063	18.148	18.233	18.318	18.404	18.490	18.575	18.660	18.745	18.830	18.915	19.000	19.085
4.3	18.490	18.576	18.662	18.749	18.836	18.923	19.010	19.097	19.184	19.271	19.358	19.445	19.532	19.619	19.706	19.793	19.880	19.967
4.4	19.360	19.448	19.536	19.625	19.714	19.803	19.892	19.981	20.070	20.160	20.250	20.340	20.430	20.520	20.610	20.700	20.790	20.880
4.5	20.250	20.340	20.430	20.521	20.612	20.703	20.794	20.885	20.976	21.068	21.160	21.252	21.344	21.436	21.528	21.620	21.712	21.804
4.6	21.160	21.252	21.344	21.437	21.530	21.623	21.716	21.809	21.902	21.996	22.090	22.184	22.278	22.372	22.466	22.560	22.654	22.750
4.7	22.090	22.184	22.278	22.373	22.468	22.563	22.658	22.753	22.848	22.944	23.040	23.135	23.232	23.329	23.426	23.523	23.620	23.717
4.8	23.040	23.135	23.232	23.329	23.426	23.523	23.620	23.717	23.814	23.912	24.010	24.108	24.205	24.303	24.401	24.500	24.600	24.701
4.9	24.010	24.108	24.206	24.305	24.404	24.503	24.604	24.702	24.800	24.900	25.000	25.100	25.200	25.301	25.402	25.503	25.604	25.705
5.0	25.000	25.100	25.200	25.301	25.402	25.503	25.604	25.705	25.806	25.908	26.008	26.108	26.208	26.309	26.409	26.509	26.609	26.709
5.1	26.010	26.112	26.214	26.317	26.419	26.523	26.626	26.729	26.832	26.936	27.039	27.142	27.245	27.348	27.451	27.554	27.657	27.760
5.2	27.040	27.144	27.248	27.353	27.458	27.563	27.668	27.773	27.878	27.984	28.094	28.202	28.306	28.409	28.516	28.623	28.730	28.837
5.3	28.090	28.196	28.302	28.409	28.516	28.623	28.730	28.837	28.944	29.050	29.157	29.264	29.371	29.478	29.585	29.692	29.799	29.896
5.4	29.160	29.268	29.376	29.485	29.594	29.703	29.812	29.921	30.030	30.140	30.248	30.356	30.464	30.572	30.680	30.788	30.896	30.994

SQUARES. FROM 1 TO 10

0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
55	30-250	30-470	30-581	30-692	30-803	30-914	31-025	31-136	31-248	11	22	33	44	55	66	77	88	99
56	31-360	31-472	31-584	31-697	31-810	31-923	32-036	32-149	32-262	11	23	34	45	57	68	79	90	100
57	32-390	32-504	32-616	32-728	32-833	32-946	33-058	33-170	33-282	11	23	35	45	58	69	81	92	104
58	33-640	33-756	33-872	33-989	34-106	34-223	34-340	34-457	34-574	11	23	35	47	59	70	83	95	107
59	34-910	34-928	35-046	35-165	35-284	35-403	35-522	35-641	35-760	35-880	12	24	36	48	60	72	84	96
60	36-800	36-120	36-240	36-361	36-482	36-603	36-724	36-845	36-966	37-088	12	24	36	48	61	73	85	97
61	37-312	37-434	37-556	37-677	37-799	37-923	38-946	39-169	39-292	39-415	12	25	37	49	62	74	86	98
62	38-440	38-564	38-688	38-813	38-938	39-063	39-188	39-313	39-438	39-564	12	25	38	50	63	75	88	100
63	39-650	39-816	40-942	40-069	40-196	40-323	40-450	40-577	40-704	40-832	13	25	38	51	64	76	89	102
64	40-960	41-088	41-216	41-345	41-474	41-603	41-732	41-861	41-990	42-120	13	26	39	52	65	77	90	103
65	42-250	42-380	42-510	42-641	42-772	42-903	43-034	43-165	43-296	43-428	13	26	39	52	65	77	90	103
66	43-560	43-692	43-824	43-957	44-080	44-223	44-356	44-489	44-622	44-756	13	27	40	53	67	80	93	106
67	44-880	45-024	45-158	45-293	45-428	45-563	45-698	45-833	45-968	46-104	14	27	41	54	68	81	95	108
68	45-240	46-376	46-512	46-649	46-786	46-923	47-060	47-197	47-334	47-472	14	27	41	55	69	82	96	110
69	47-610	47-738	47-886	48-025	48-164	48-303	48-442	48-581	48-720	48-860	14	28	42	56	70	83	97	111
70	49-000	49-140	49-280	49-421	49-562	49-703	49-844	49-985	50-126	50-268	14	28	42	56	71	85	99	113
71	50-410	50-552	50-694	50-837	50-980	51-123	51-266	51-409	51-552	51-696	14	29	43	57	72	86	100	114
72	51-840	51-984	52-128	52-273	52-418	52-563	52-708	52-853	52-998	53-144	15	29	44	58	73	87	102	116
73	53-290	53-446	53-582	53-729	53-876	54-023	54-170	54-317	54-464	55-612	15	29	44	59	74	88	103	118
74	54-760	54-908	55-056	55-205	55-354	55-503	55-652	55-801	55-950	56-100	15	30	45	60	75	80	104	119
75	56-250	56-400	56-550	56-701	56-852	57-003	57-154	57-305	57-456	57-608	15	30	45	60	76	91	106	121
76	57-760	57-912	58-064	58-217	58-370	58-523	58-676	58-829	59-982	59-136	15	31	46	61	77	92	107	122

0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
77	59-290	59-444	59-598	59-753	59-908	60-063	60-218	60-373	60-528	60-684	16	31	47	62	78	93	109	124
78	60-840	60-996	61-152	61-309	61-466	61-623	61-780	61-937	62-094	62-252	16	32	48	64	80	95	111	126
79	62-410	62-568	62-726	62-885	63-034	63-191	63-362	63-521	63-680	63-840	16	32	48	64	80	95	111	127
80	64-000	64-160	64-320	64-481	64-642	64-803	64-964	65-125	65-286	65-446	16	32	48	64	81	97	113	129
81	65-610	65-772	65-934	66-097	66-250	66-423	66-586	66-749	66-912	67-076	17	33	49	65	82	98	114	130
82	67-240	67-404	67-568	67-733	67-890	68-063	68-228	68-393	68-558	68-724	17	33	50	66	83	99	116	132
83	68-890	69-056	69-222	69-389	69-556	69-723	69-890	70-057	70-224	70-392	17	33	50	67	84	100	117	134
84	70-560	70-728	70-896	71-065	71-234	71-403	71-572	71-741	71-910	72-080	17	34	51	68	85	101	118	135
85	72-250	72-420	72-590	72-761	72-932	73-103	73-274	73-445	73-616	73-788	17	34	51	68	86	103	120	137
86	73-960	75-122	74-304	74-476	74-650	74-823	74-996	75-169	75-342	75-516	17	35	53	70	88	105	123	140
87	76-490	75-864	76-038	76-213	76-388	76-563	76-738	76-913	77-088	77-264	18	35	53	71	89	106	124	142
88	77-440	77-616	77-792	77-969	78-146	78-323	78-500	78-677	78-854	79-032	18	36	54	72	90	107	125	143
89	79-210	79-388	79-566	79-743	79-912	80-103	80-282	80-461	80-640	80-820	18	36	54	72	90	107	125	143
90	81-000	81-180	81-360	81-541	81-722	81-903	82-084	82-265	82-446	82-628	18	36	54	72	91	109	127	145
91	82-810	82-992	83-174	83-357	83-539	83-721	83-906	84-089	84-272	84-456	18	37	55	73	92	110	128	146
92	84-640	84-824	85-008	85-193	85-378	85-563	85-748	85-933	86-118	86-304	19	37	56	74	93	111	130	148
93	86-490	86-676	86-862	87-049	87-236	87-423	87-610	87-797	87-984	88-172	19	37	56	75	94	112	131	150
94	88-360	88-548	88-736	88-925	89-114	89-303	89-492	89-681	89-870	90-060	19	38	57	76	95	113	132	151
95	90-440	90-630	92-544	92-737	92-930	93-123	93-316	93-509	93-702	93-896	19	38	57	76	96	115	134	153
96	92-160	92-352	94-478	94-673	94-868	95-063	95-238	95-453	95-648	95-844	19	39	58	77	97	116	135	154
97	94-990	94-284	94-478	94-673	94-868	96-023	96-216	96-417	96-614	97-812	20	39	59	78	98	117	137	156
98	96-040	96-236	96-432	96-629	96-826	97-220	97-417	97-614	97-812	99-800	20	40	60	80	100	119	139	159
99	98-010	98-208	98-406	98-605	98-804	99-003	99-202	99-401	99-600	99-800	20	40	60	80	100	119	139	159

SQUARE ROOTS. FROM 1 TO 10

0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
1.0	1.0000	1.0050	1.0100	1.0149	1.0198	1.0247	1.0296	1.0344	1.0392
1.1	1.0488	1.0536	1.0583	1.0630	1.0677	1.0724	1.0770	1.0817	1.0863
1.2	1.0954	1.1000	1.1045	1.1091	1.1136	1.1180	1.1225	1.1269	1.1314
1.3	1.1402	1.1446	1.1489	1.1533	1.1576	1.1619	1.1662	1.1705	1.1747
1.4	1.1832	1.1874	1.1916	1.1958	1.2000	1.2042	1.2083	1.2124	1.2166
1.5	1.2247	1.2288	1.2329	1.2369	1.2410	1.2450	1.2490	1.2530	1.2570
1.6	1.2649	1.2689	1.2728	1.2767	1.2806	1.2845	1.2884	1.2923	1.2961
1.7	1.3038	1.3077	1.3115	1.3153	1.3191	1.3229	1.3266	1.3304	1.3342
1.8	1.3416	1.3454	1.3491	1.3528	1.3565	1.3601	1.3638	1.3675	1.3711
1.9	1.3784	1.3820	1.3856	1.3892	1.3928	1.3964	1.4000	1.4036	1.4071
2.0	1.4142	1.4177	1.4213	1.4248	1.4283	1.4318	1.4353	1.4387	1.4422
2.1	1.4491	1.4526	1.4560	1.4595	1.4629	1.4663	1.4697	1.4731	1.4765
2.2	1.4832	1.4866	1.4900	1.4933	1.4966	1.5000	1.5033	1.5067	1.5100
2.3	1.5166	1.5199	1.5232	1.5264	1.5297	1.5330	1.5362	1.5393	1.5427
2.4	1.5492	1.5524	1.5556	1.5588	1.5620	1.5652	1.5684	1.5716	1.5748
2.5	1.5811	1.5843	1.5875	1.5906	1.5937	1.5969	1.6000	1.6031	1.6062
2.6	1.6125	1.6155	1.6186	1.6217	1.6248	1.6279	1.6310	1.6340	1.6371
2.7	1.6432	1.6462	1.6492	1.6523	1.6553	1.6583	1.6613	1.6643	1.6673
2.8	1.6733	1.6763	1.6793	1.6823	1.6852	1.6882	1.6912	1.6941	1.6971
2.9	1.7029	1.7059	1.7088	1.7117	1.7146	1.7176	1.7205	1.7234	1.7263
3.0	1.7321	1.7349	1.7378	1.7407	1.7436	1.7464	1.7493	1.7521	1.7550
3.1	1.7607	1.7633	1.7664	1.7692	1.7720	1.7748	1.7776	1.7804	1.7833

0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
3.2	1.7889	1.7916	1.7944	1.7972	1.8000	1.8028	1.8055	1.8083	1.8111
3.3	1.8166	1.8193	1.8221	1.8248	1.8276	1.8303	1.8330	1.8358	1.8385
3.4	1.8449	1.8466	1.8493	1.8520	1.8547	1.8574	1.8601	1.8628	1.8655
3.5	1.8708	1.8735	1.8762	1.8788	1.8815	1.8841	1.8868	1.8894	1.8921
3.6	1.8974	1.9000	1.9026	1.9053	1.9079	1.9105	1.9131	1.9157	1.9183
3.7	1.9235	1.9261	1.9287	1.9313	1.9339	1.9365	1.9391	1.9416	1.9442
3.8	1.9594	1.9519	1.9545	1.9570	1.9596	1.9621	1.9647	1.9672	1.9698
3.9	1.9874	1.9774	1.9799	1.9824	1.9849	1.9875	1.9900	1.9925	1.9950
4.0	2.0000	2.0025	2.0050	2.0075	2.0100	2.0125	2.0149	2.0174	2.0219
4.1	2.0248	2.0273	2.0309	2.0334	2.0362	2.0397	2.0432	2.0469	2.0506
4.2	2.0494	2.0518	2.0543	2.0567	2.0591	2.0616	2.0640	2.0664	2.0688
4.3	2.0736	2.0761	2.0785	2.0809	2.0833	2.0857	2.0881	2.0905	2.0928
4.4	2.0976	2.0000	2.1024	2.1048	2.1071	2.1095	2.1119	2.1142	2.1166
4.5	2.1213	2.1237	2.1260	2.1284	2.1307	2.1331	2.1354	2.1378	2.1403
4.6	2.1448	2.1471	2.1494	2.1517	2.1541	2.1564	2.1587	2.1610	2.1633
4.7	2.1679	2.1703	2.1726	2.1749	2.1772	2.1794	2.1817	2.1840	2.1863
4.8	2.1909	2.1932	2.1954	2.1977	2.2000	2.2023	2.2045	2.2068	2.2091
4.9	2.2136	2.2159	2.2181	2.2204	2.2226	2.2249	2.2271	2.2293	2.2316
5.0	2.2361	2.2383	2.2405	2.2428	2.2450	2.2472	2.2494	2.2517	2.2539
5.1	2.2583	2.2605	2.2627	2.2650	2.2672	2.2694	2.2716	2.2738	2.2760
5.2	2.2804	2.2825	2.2847	2.2869	2.2891	2.2913	2.2935	2.2956	2.2978
5.3	2.3022	2.3043	2.3065	2.3087	2.3108	2.3130	2.3152	2.3173	2.3195
5.4	2.3238	2.3259	2.3281	2.3302	2.3324	2.3345	2.3367	2.3388	2.3409

SQUARE ROOTS. From 1 to 10

0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
55	2.3452	2.3495	2.3516	2.3537	2.3558	2.3580	2.3602	2.3622	2.3643	2	4	6	8	11	13	15	17	19
56	2.3664	2.3685	2.3707	2.3728	2.3749	2.3769	2.3791	2.3812	2.3832	2.3854	2	4	6	8	11	13	15	17
57	2.3875	2.3896	2.4104	2.4145	2.4166	2.4187	2.4207	2.4228	2.4249	2.4269	2	4	6	8	10	12	14	16
58	2.4083	2.4100	2.4310	2.4331	2.4352	2.4372	2.4393	2.4413	2.4434	2.4454	2.4474	2	4	6	8	10	12	14
59	2.4290	2.4495	2.4515	2.4536	2.4556	2.4576	2.4597	2.4617	2.4637	2.4658	2.4678	2	4	6	8	10	12	14
60	2.4698	2.4699	2.4718	2.4739	2.4759	2.4779	2.4799	2.4819	2.4839	2.4860	2.4880	2.4900	2.4920	2.4940	2.4960	2.4980	2.5000	2.5016
61	2.4900	2.4920	2.4940	2.5120	2.5140	2.5159	2.5179	2.5199	2.5219	2.5239	2.5259	2.5278	2.5297	2.5317	2.5337	2.5357	2.5377	2.5397
62	2.5100	2.5298	2.5318	2.5338	2.5357	2.5377	2.5397	2.5417	2.5436	2.5456	2.5475	2	4	6	8	10	12	14
63	2.5495	2.5515	2.5534	2.5554	2.5573	2.5593	2.5612	2.5632	2.5652	2.5671	2.5690	2.5700	2.5719	2.5738	2.5757	2.5776	2.5795	2.5814
64	2.5690	2.5710	2.5729	2.5749	2.5768	2.5783	2.5807	2.5826	2.5846	2.5865	2.5884	2.5903	2.5923	2.5942	2.5962	2.5982	2.6000	2.6019
65	2.5884	2.6077	2.6287	2.6306	2.6325	2.6344	2.6363	2.6382	2.6401	2.6420	2.6439	2	4	6	8	10	11	13
66	2.6268	2.6458	2.6476	2.6495	2.6514	2.6533	2.6552	2.6571	2.6589	2.6608	2.6627	2	4	6	8	9	11	13
67	2.6851	2.6883	2.6904	2.6915	2.6934	2.6953	2.6972	2.6991	2.7010	2.7029	2.7048	2.7067	2.7086	2.7105	2.7124	2.7143	2.7162	2.7181
68	2.6906	2.6927	2.6946	2.6965	2.6983	2.7002	2.7021	2.7041	2.7060	2.7079	2.7098	2	4	6	7	9	11	13
69	2.7037	2.7053	2.7073	2.7093	2.7111	2.7129	2.7148	2.7166	2.7185	2.7203	2.7221	2	4	6	7	9	11	13
70	2.7221	2.7238	2.7240	2.7258	2.7276	2.7295	2.7313	2.7331	2.7350	2.7368	2.7386	2	4	6	7	9	11	13
71	2.6646	2.6833	2.6851	2.6870	2.6889	2.6907	2.6926	2.6944	2.6963	2.6981	2.6999	2	4	6	7	9	11	13
72	2.6851	2.6933	2.6951	2.6970	2.6989	2.7007	2.7026	2.7045	2.7064	2.7083	2.7102	2	4	6	7	9	11	13
73	2.7037	2.7053	2.7073	2.7093	2.7111	2.7129	2.7148	2.7166	2.7185	2.7203	2.7221	2	4	6	7	9	11	13
74	2.7221	2.7336	2.7404	2.7423	2.7441	2.7459	2.7477	2.7495	2.7514	2.7532	2.7550	2	4	6	7	9	11	13
75	2.7356	2.7568	2.7586	2.7604	2.7622	2.7641	2.7659	2.7677	2.7695	2.7713	2.7731	2	4	6	7	9	11	13
76	2.7568	2.7586	2.7604	2.7622	2.7641	2.7659	2.7677	2.7695	2.7713	2.7731	2	4	6	7	9	11	13	14

0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
77	2.7749	2.7767	2.7785	2.7803	2.7821	2.7839	2.7857	2.7875	2.7893	2.7911	2	4	5	7	9	11	13	14
78	2.7928	2.8107	2.8125	2.8142	2.8160	2.8178	2.8196	2.8213	2.8231	2.8249	2.8267	2	4	5	7	9	11	12
79	2.8320	2.8424	2.8502	2.8513	2.8531	2.8550	2.8568	2.8586	2.8604	2.8622	2.8640	2	4	5	7	9	11	12
80	2.8460	2.8478	2.8496	2.8513	2.8531	2.8550	2.8568	2.8586	2.8604	2.8622	2.8640	2	4	5	7	9	11	12
81	2.8636	2.8653	2.8671	2.8688	2.8705	2.8723	2.8740	2.8758	2.8775	2.8792	2.8810	2	4	5	7	9	10	12
82	2.8844	2.8853	2.8871	2.8889	2.8897	2.8906	2.8914	2.8922	2.8930	2.8948	2.8965	2	4	5	7	9	10	12
83	2.8983	2.9000	2.9017	2.9034	2.9052	2.9069	2.9086	2.9103	2.9120	2.9138	2.9155	2	4	5	7	9	10	12
84	2.9189	2.9206	2.9223	2.9240	2.9257	2.9275	2.9292	2.9309	2.9326	2.9343	2.9361	2	4	5	7	9	10	12
85	2.9155	2.9172	2.9189	2.9206	2.9223	2.9240	2.9257	2.9275	2.9292	2.9309	2.9326	2	4	5	7	9	10	12
86	2.9326	2.9343	2.9360	2.9377	2.9394	2.9411	2.9428	2.9445	2.9462	2.9479	2.9497	2	4	5	7	9	10	12
87	2.9496	2.9513	2.9530	2.9547	2.9563	2.9580	2.9597	2.9614	2.9631	2.9648	2.9665	2	4	5	7	9	10	12
88	2.9663	2.9682	2.9698	2.9715	2.9732	2.9749	2.9766	2.9783	2.9799	2.9816	2.9833	2	4	5	7	9	10	12
89	2.9833	2.9850	2.9866	2.9883	2.9900	2.9917	2.9933	2.9950	2.9967	2.9983	2.9993	2	4	5	7	9	10	12
90	3.0017	3.0033	3.0050	3.0067	3.0083	3.0100	3.0116	3.0133	3.0150	3.0167	3.0184	2	4	5	7	9	10	12
91	3.0166	3.0183	3.0199	3.0216	3.0232	3.0249	3.0265	3.0282	3.0300	3.0315	3.0332	2	4	5	7	9	10	12
92	3.0332	3.0348	3.0364	3.0381	3.0397	3.0414	3.0430	3.0447	3.0463	3.0480	3.0497	2	4	5	7	9	10	12
93	3.0496	3.0512	3.0529	3.0545	3.0561	3.0578	3.0594	3.0610	3.0627	3.0643	3.0660	2	4	5	7	9	10	12
94	3.0659	3.0676	3.0692	3.0708	3.0725	3.0741	3.0757	3.0773	3.0790	3.0797	3.0814	2	4	5	7	9	10	12
95	3.0822	3.0838	3.0854	3.0871	3.0887	3.0903	3.0919	3.0935	3.0952	3.0968	3.0984	2	4	5	7	9	10	12
96	3.0984	3.1000	3.1016	3.1032	3.1048	3.1064	3.1081	3.1097	3.1113	3.1129	3.1145	2	4	5	7	9	10	12
97	3.1145	3.1161	3.1177	3.1193	3.1209	3.1225	3.1241	3.1257	3.1273	3.1289	3.1305	2	4	5	7	9	10	12
98	3.1305	3.1321	3.1337	3.1353	3.1369	3.1385	3.1401	3.1417	3.1432	3.1448	3.1464	2	4	5	7	9	10	12
99	3.1464	3.1480	3.1496	3.1512	3.1528	3.1544	3.1559	3.1575	3.1591	3.1607	3.1624	2	4	5	7	9	10	12

SQUARE ROOTS. FROM 10 TO 100

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
10	3.1623	3.1780	3.1937	3.2094	3.2249	3.2404	3.2558	3.2711	3.2863	3.3015	15.31	46	62.77	92	108	123	139		
11	3.3166	3.3317	3.3466	3.3615	3.3764	3.3912	3.4059	3.4205	3.4351	3.4496	15.30	44	59.74	89	104	118	133		
12	3.4641	3.4785	3.4928	3.5071	3.5214	3.5355	3.5496	3.5637	3.5777	3.5917	14.28	43	57.71	85	99	114	128		
13	3.6056	3.6194	3.6332	3.6469	3.6606	3.6742	3.6878	3.7014	3.7148	3.7283	14.27	41	54.68	82	95	109	122		
14	3.7417	3.7550	3.7683	3.7815	3.7947	3.8079	3.8210	3.8341	3.8471	3.8601	13.26	39	52.66	79	92	105	118		
15	3.8730	3.8859	3.8987	3.9115	3.9243	3.9370	3.9497	3.9623	3.9749	3.9875	13.25	38	51.64	76	89	102	114		
16	4.0000	4.0125	4.0249	4.0373	4.0497	4.0620	4.0743	4.0866	4.0988	4.1110	12.25	37	51.62	74	86	98	111		
17	4.1231	4.1352	4.1473	4.1593	4.1713	4.1833	4.1952	4.2071	4.2190	4.2308	12.24	36	48.60	72	84	96	108		
18	4.2426	4.2544	4.2661	4.2778	4.2895	4.3012	4.3128	4.3243	4.3359	4.3474	12.23	35	46.58	70	81	93	104		
19	4.3589	4.3704	4.3818	4.3932	4.4045	4.4159	4.4272	4.4385	4.4497	4.4609	11.23	34	45.57	68	79	90	102		
20	4.4721	4.4833	4.4944	4.5056	4.5166	4.5277	4.5387	4.5497	4.5607	4.5717	11.22	33	44.56	65	76	87	99		
21	4.5826	4.5935	4.6043	4.6152	4.6260	4.6368	4.6476	4.6583	4.6690	4.6797	11.21	32	43.54	63	74	84	95		
22	4.6904	4.7011	4.7117	4.7223	4.7329	4.7424	4.7539	4.7645	4.7749	4.7854	10.19	29	39.49	58	68	78	87		
23	4.7958	4.8062	4.8166	4.8270	4.8374	4.8477	4.8580	4.8683	4.8785	4.8888	10.18	28	38.48	57	67	76	86		
24	4.8990	4.9092	4.9193	4.9295	4.9396	4.9497	4.9598	4.9699	4.9800	4.9900	10.20	30	40.51	61	71	81	91		
25	5.0000	5.0100	5.0200	5.0299	5.0398	5.0498	5.0595	5.0693	5.0794	5.0892	10.20	30	40.50	59	69	79	89		
26	5.0990	5.1088	5.1186	5.1284	5.1381	5.1478	5.1575	5.1672	5.1769	5.1865	10.19	29	39.49	58	68	78	87		
27	5.1962	5.2058	5.2154	5.2249	5.2345	5.2440	5.2536	5.2631	5.2726	5.2820	10.19	29	38.48	57	67	76	85		
28	5.2915	5.3009	5.3104	5.3198	5.3292	5.3385	5.3479	5.3572	5.3666	5.3759	9.19	28	38.47	56	66	75	83		
29	5.3832	5.3944	5.4037	5.4129	5.4222	5.4314	5.4406	5.4498	5.4589	5.4681	9.18	28	37.46	55	64	74	82		
30	5.4772	5.4863	5.4955	5.5045	5.5136	5.5227	5.5317	5.5408	5.5498	5.5588	9.18	27	36.46	55	64	73	80		
31	5.5678	5.5767	5.5857	5.5946	5.6036	5.6125	5.6214	5.6303	5.6391	5.6480	9.18	27	36.45	53	62	71	80		

	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
32	5.6657	5.6745	5.6833	5.6921	5.7009	5.7096	5.7184	5.7271	5.7359	5.7446	9.18	26	35.44	53	62	70	79		
33	5.7446	5.7533	5.7619	5.7706	5.7793	5.7879	5.7966	5.8052	5.8138	5.8224	9.17	26	34.43	52	60	69	77		
34	5.8310	5.8395	5.8481	5.8566	5.8652	5.8737	5.8822	5.8907	5.8992	5.9076	9.17	26	34.43	51	60	68	77		
35	5.9161	5.9245	5.9330	5.9414	5.9498	5.9582	5.9666	5.9749	5.9833	5.9917	8.17	25	34.42	50	59	67	76		
36	6.0000	6.0083	6.0166	6.0249	6.0332	6.0415	6.0498	6.0581	6.0663	6.0745	8.17	25	33.42	50	58	66	75		
37	6.0828	6.0910	6.0992	6.1074	6.1156	6.1237	6.1319	6.1400	6.1482	6.1563	8.16	25	33.41	49	57	66	74		
38	6.1644	6.1725	6.1806	6.1887	6.1968	6.2048	6.2129	6.2209	6.2289	6.2370	8.16	24	32.41	49	57	65	73		
39	6.2430	6.2530	6.2610	6.2690	6.2769	6.2849	6.2929	6.3008	6.3087	6.3166	8.16	24	32.40	48	56	64	72		
40	6.3246	6.3325	6.3403	6.3482	6.3561	6.3640	6.3718	6.3797	6.3875	6.3953	8.16	24	32.40	47	55	63	71		
41	6.4031	6.4109	6.4187	6.4265	6.4343	6.4420	6.4498	6.4576	6.4653	6.4730	8.16	23	31.39	47	55	62	70		
42	6.4807	6.4885	6.4962	6.5038	6.5115	6.5192	6.5269	6.5345	6.5422	6.5498	8.15	23	31.38	46	54	61	69		
43	6.5574	6.5651	6.5729	6.5803	6.5878	6.6053	6.6130	6.6208	6.6285	6.6363	8.15	23	30.38	46	53	61	68		
44	6.6332	6.6408	6.6483	6.6560	6.6633	6.6708	6.6783	6.6858	6.6933	6.7007	8.15	23	30.38	45	53	60	68		
45	6.7082	6.7157	6.7231	6.7305	6.7380	6.7454	6.7528	6.7602	6.7676	6.7750	7.15	22	29.37	44	52	59	67		
46	6.7823	6.7897	6.7971	6.8044	6.8118	6.8191	6.8264	6.8337	6.8411	6.8484	7.15	22	29.36	43	50	57	64		
47	6.8557	6.8632	6.8702	6.8775	6.8848	6.8920	6.8993	6.9065	6.9138	6.9210	7.14	21	28.36	43	50	57	64		
48	6.9282	6.9354	6.9426	6.9498	6.9570	6.9642	6.9714	6.9785	6.9857	6.9929	7.14	21	28.35	42	49	56	63		
49	7.0000	7.0071	7.0143	7.0214	7.0285	7.0356	7.0427	7.0498	7.0569	7.0640	7.14	21	28.34	41	48	54	61		
50	7.0711	7.0781	7.0852	7.0922	7.0993	7.1063	7.1134	7.1204	7.1274	7.1344	7.14	21	28.33	40	48	54	61		
51	7.1414	7.1484	7.1554	7.1624	7.1694	7.1764	7.1833	7.1903	7.1972	7.2042	7.14	21	28.32	39	47	54	61		
52	7.2111	7.2180	7.2250	7.2319	7.2388	7.2457	7.2526	7.2595	7.2664	7.2732	7.14	20	27.34	41	48	54	61		
53	7.2801	7.2870	7.2938	7.3007	7.3075	7.3144	7.3212	7.3280	7.3348	7.3417	7.14	20	27.34	41	48	54	61		
54	7.3485	7.3553	7.3621	7.3689	7.3756	7.3824	7.3892	7.3959	7.4027	7.4095	7.14	20	27.34	41	48	54	61		
	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

SQUARE ROOTS. FROM 10 TO 100

0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
55 7-4162	7-4229	7-4297	7-4364	7-4431	7-4498	7-4565	7-4632	7-4699	7-4766	7-13 20	27 34 40	47 54 60						
56 7-4833	7-4900	7-4967	7-5033	7-5100	7-5166	7-5233	7-5299	7-5366	7-5432	7-13 20	27 34 40	47 54 60						
57 7-5498	7-5565	7-5631	7-5697	7-5763	7-5829	7-5895	7-5961	7-6026	7-6092	7-13 20	26 33 40	46 53 59						
58 7-6158	7-6223	7-6289	7-6354	7-6425	7-6485	7-6551	7-6616	7-6681	7-6746	7-13 20	26 33 39	46 52 59						
59 7-6811	7-6877	7-6942	7-7006	7-7071	7-7136	7-7201	7-7266	7-7330	7-7395	7-13 20	26 33 39	46 52 59						
60 7-7460	7-7524	7-7589	7-7653	7-7717	7-7782	7-7846	7-7910	7-7974	7-8038	7-13 19	26 32 38	45 51 58						
61 7-8102	7-8166	7-8230	7-8294	7-8358	7-8422	7-8486	7-8549	7-8613	7-8677	6-13 19	26 32 38	45 51 58						
62 7-8740	7-8804	7-8867	7-8930	7-8994	7-9057	7-9120	7-9183	7-9246	7-9310	6-13 19	25 32 38	44 50 57						
63 7-9373	7-9436	7-9498	7-9561	7-9624	7-9687	7-9750	7-9812	7-9875	7-9937	6-13 19	25 32 38	44 50 57						
64 8-0000	8-0062	8-0125	8-0187	8-0250	8-0312	8-0374	8-0436	8-0498	8-0561	6-12 19	25 31 37	43 50 56						
65 8-0623	8-0685	8-0747	8-0808	8-0870	8-0932	8-0994	8-1056	8-1117	8-1179	6-12 19	25 31 37	43 50 56						
66 8-1240	8-1302	8-1363	8-1425	8-1486	8-1548	8-1609	8-1670	8-1731	8-1792	6-12 18	24 31 37	43 49 55						
67 8-1854	8-1915	8-1976	8-2037	8-2098	8-2158	8-2219	8-2280	8-2341	8-2401	6-12 18	24 31 37	43 49 55						
68 8-2462	8-2523	8-2583	8-2644	8-2704	8-2765	8-2825	8-2885	8-2946	8-3006	6-12 18	24 30 36	42 48 54						
69 8-3066	8-3126	8-3187	8-3247	8-3307	8-3367	8-3427	8-3487	8-3546	8-3606	6-12 18	24 30 36	42 48 54						
70 8-3666	8-3726	8-3785	8-3845	8-3905	8-3964	8-4024	8-4083	8-4143	8-4202	6-12 18	24 30 36	42 48 54						
71 8-4261	8-4321	8-4380	8-4439	8-4499	8-4558	8-4617	8-4676	8-4735	8-4794	6-12 18	24 30 35	41 47 53						
72 8-4853	8-4912	8-4971	8-5029	8-5088	8-5147	8-5206	8-5264	8-5323	8-5381	6-12 18	24 30 35	41 47 53						
73 8-5440	8-5499	8-5557	8-5615	8-5674	8-5732	8-5790	8-5849	8-5907	8-5965	6-12 17	23 29 35	41 46 52						
74 8-0023	8-0081	8-0139	8-0197	8-0255	8-0313	8-0371	8-0429	8-0487	8-0545	6-12 17	23 29 35	41 46 52						
75 8-6603	8-6660	8-6718	8-6776	8-6833	8-6891	8-6948	8-7006	8-7063	8-7121	6-12 17	23 29 35	41 46 52						
76 8-7178	8-7235	8-7293	8-7350	8-7407	8-7464	8-7521	8-7579	8-7636	8-7693	6-11 17	23 29 34	40 46 51						

0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
77 8-7750	8-7807	8-7864	8-7920	8-7977	8-8034	8-8091	8-8148	8-8204	8-8261	6-11 17	23 29 34	39 45 50						
78 8-8318	8-8374	8-8431	8-8487	8-8544	8-8600	8-8657	8-8713	8-8769	8-8826	6-11 17	22 28 34	39 45 50						
79 8-8882	8-8938	8-8994	8-9051	8-9107	8-9163	8-9219	8-9273	8-9331	8-9387	6-11 17	22 28 34	39 45 50						
80 8-9443	8-9499	8-9554	8-9610	8-9666	8-9722	8-9778	8-9833	8-9889	8-9944	6-11 17	22 28 34	39 45 50						
81 9-0056	9-0111	9-0167	9-0222	9-0277	9-0333	9-0389	9-0443	9-0499	9-0545	6-11 17	22 28 33	39 44 50						
82 9-0609	9-0664	9-0719	9-0774	9-0830	9-0885	9-0940	9-0995	9-1049	9-1099	6-11 17	22 28 33	39 44 50						
83 9-1104	9-1159	9-1214	9-1269	9-1324	9-1378	9-1433	9-1488	9-1542	9-1597	6-11 17	22 28 33	39 44 50						
84 9-1652	9-1706	9-1761	9-1815	9-1869	9-1924	9-1978	9-2033	9-2087	9-2141	5-11 16	22 27 32	38 43 49						
85 9-2195	9-2250	9-2304	9-2358	9-2412	9-2466	9-2520	9-2574	9-2628	9-2682	5-11 16	22 27 32	38 43 49						
86 9-2324	9-2376	9-2431	9-2484	9-2538	9-3039	9-3305	9-3367	9-3422	9-3755	5-11 16	21 27 32	37 42 48						
87 9-3327	9-3381	9-3434	9-3488	9-3541	9-3595	9-3648	9-3702	9-3757	9-4287	5-11 16	21 27 32	37 42 48						
88 9-3808	9-3862	9-3915	9-3968	9-4021	9-4074	9-4128	9-4181	9-4234	9-4287	5-11 16	21 27 32	37 42 48						
89 9-4340	9-4393	9-4446	9-4499	9-4552	9-4604	9-4657	9-4710	9-4763	9-4816	5-11 16	21 27 32	37 42 48						
90 9-4668	9-4921	9-4974	9-5026	9-5079	9-5131	9-5184	9-5237	9-5289	9-5341	5-11 16	21 27 32	37 42 48						
91 9-5394	9-5446	9-5499	9-5551	9-5603	9-5656	9-5708	9-5760	9-5812	9-5864	5-11 16	21 26 31	36 42 47						
92 9-5917	9-5969	9-6021	9-6073	9-6125	9-6177	9-6229	9-6281	9-6333	9-6385	5-11 16	21 26 31	36 42 47						
93 9-6437	9-6488	9-6540	9-6592	9-6644	9-6695	9-6747	9-6798	9-6850	9-6902	5-10 15	20 25 30	35 40 45						
94 9-6954	9-7005	9-7057	9-7108	9-7160	9-7211	9-7263	9-7314	9-7365	9-7417	5-10 15	20 26 31	36 41 46						
95 9-7468	9-7519	9-7570	9-7622	9-7673	9-7724	9-7775	9-7826	9-7877	9-7929	5-10 15	20 26 31	36 41 46						
96 9-7920	9-8031	9-8082	9-8133	9-8184	9-8235	9-8285	9-8336	9-8387	9-8438	5-10 15	20 26 31	36 41 46						
97 9-8489	9-8539	9-8590	9-8641	9-8691	9-8742	9-8793	9-8843	9-8894	9-8944	5-10 15	20 26 31	36 41 46						
98 9-8895	9-9045	9-9096	9-9146	9-9197	9-9247	9-9298	9-9348	9-9398	9-9448	5-10 15	20 25 30	35 40 45						
99 9-9499	9-9549	9-9599	9-9649	9-9700	9-9750	9-9800	9-9850	9-9900	9-9950	5-10 15	20 25 30	35 40 45						
0 0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9

CUBES OF NUMBERS. FROM 1 TO 10

	0	1	2	3	4	5	6	7	8	9
1.0	1.0000	1.0303	1.0612	1.0927	1.1249	1.1576	1.1910	1.2250	1.2597	1.2950
1.1	1.3310	1.3676	1.4049	1.4429	1.4815	1.5209	1.5609	1.6016	1.6430	1.6852
1.2	1.7280	1.7716	1.8158	1.8609	1.9066	1.9531	2.0004	2.0484	2.0972	2.1467
1.3	2.1970	2.2481	2.3000	2.3526	2.4061	2.4604	2.5155	2.5714	2.6281	2.6856
1.4	2.7440	2.8032	2.8633	2.9242	2.9860	3.0486	3.1121	3.1765	3.2418	3.3079
1.5	3.3750	3.4430	3.5118	3.5816	3.6523	3.7239	3.7964	3.8699	3.9443	4.0197
1.6	4.0960	4.1733	4.2515	4.3307	4.4109	4.4921	4.5743	4.6575	4.7416	4.8268
1.7	4.9130	5.0002	5.0884	5.1777	5.2680	5.3594	5.4518	5.5452	5.6398	5.7353
1.8	5.8320	5.9297	6.0286	6.1285	6.2295	6.3316	6.4349	6.5392	6.6447	6.7513
1.9	6.8590	6.9679	7.0779	7.1891	7.3014	7.4149	7.5295	7.6454	7.7624	7.8806
2.0	8.0000	8.1206	8.2424	8.3654	8.4897	8.6151	8.7418	8.8697	8.9989	9.1293
2.1	9.2610	9.3939	9.5281	9.6636	9.8003	9.9384	10.078	10.218	10.360	10.503
2.2	10.648	10.794	10.941	11.090	11.239	11.391	11.543	11.697	11.852	12.009
2.3	12.167	12.326	12.487	12.649	12.813	12.978	13.144	13.312	13.481	13.652
2.4	13.824	13.998	14.172	14.349	14.527	14.706	14.887	15.069	15.253	15.438
2.5	15.625	15.813	16.003	16.194	16.387	16.581	16.777	16.975	17.174	17.374
2.6	17.576	17.780	17.985	18.191	18.400	18.610	18.821	19.034	19.249	19.465
2.7	19.683	19.903	20.124	20.346	20.571	20.797	21.025	21.254	21.485	21.718
2.8	21.952	22.188	22.426	22.665	22.906	23.149	23.394	23.640	23.888	24.138
2.9	24.389	24.642	24.897	25.154	25.412	25.672	25.934	26.198	26.464	26.731
3.0	27.000	27.271	27.544	27.818	28.094	28.373	28.653	28.934	29.218	29.504
3.1	29.791	30.080	30.371	30.664	30.959	31.256	31.554	31.855	32.157	32.462

	0	1	2	3	4	5	6	7	8	9
32	32.768	33.076	33.386	33.698	34.012	34.328	34.646	34.966	35.288	35.611
33	35.937	36.265	36.594	36.926	37.260	37.595	37.933	38.273	38.614	38.953
34	39.304	39.652	40.002	40.354	40.708	41.064	41.422	41.782	42.144	42.509
35	42.875	43.244	43.614	43.987	44.362	44.739	45.118	45.499	45.883	46.268
36	46.656	47.046	47.438	47.832	48.229	48.627	49.028	49.431	49.836	50.243
37	50.653	51.065	51.479	51.895	52.314	52.734	53.157	53.583	54.010	54.440
38	54.872	55.306	55.743	56.182	56.623	57.067	57.512	57.961	58.411	58.864
39	59.319	59.776	60.236	60.698	61.163	61.630	62.099	62.571	63.045	63.521
40	64.000	64.481	64.965	65.451	65.939	66.430	66.923	67.419	67.917	68.418
41	68.921	69.427	70.935	70.445	71.958	71.473	71.991	72.512	73.035	73.560
42	74.088	74.618	75.151	75.687	76.225	76.766	77.309	77.854	78.403	78.954
43	79.507	80.063	80.622	81.183	81.747	82.313	82.882	83.453	84.028	84.605
44	85.184	85.766	86.351	86.938	87.528	88.121	88.717	89.315	89.915	90.519
45	91.125	91.734	92.345	92.960	93.577	94.196	94.819	95.444	96.072	96.703
46	97.336	97.972	98.611	99.253	99.897	100.54	101.19	101.85	102.50	103.16
47	103.82	104.49	105.15	105.82	106.50	107.17	107.85	108.53	109.22	109.90
48	110.59	111.28	111.98	112.68	113.38	114.08	114.79	115.50	116.21	116.93
49	117.65	118.37	119.10	119.82	120.55	121.29	122.02	122.76	123.51	124.25
50	125.00	125.75	126.51	127.26	128.02	128.79	129.55	130.32	131.10	131.87
51	132.65	133.43	134.22	135.01	135.80	136.59	137.39	138.19	138.99	139.80
52	140.61	141.42	142.24	143.06	143.88	144.70	145.53	146.36	147.20	148.04
53	148.88	149.72	150.57	151.42	152.27	153.13	153.99	154.85	155.72	156.59
54	157.46	158.34	159.22	160.10	160.99	161.88	162.77	163.67	164.57	165.47
	0	1	2	3	4	5	6	7	8	9

CUBES OF NUMBERS. FROM 1 TO 10

	0	1	2	3	4	5	6	7	8	9
5.5	166.38	167.28	168.20	169.11	170.03	170.95	171.88	172.81	173.74	174.68
5.6	175.62	176.56	177.50	178.45	179.41	180.36	181.32	182.28	183.25	184.22
5.7	185.19	186.17	187.15	188.13	189.12	190.11	191.10	192.10	193.10	194.10
5.8	195.11	196.12	197.14	198.16	199.18	200.20	201.23	202.26	203.30	204.34
5.9	205.37	206.43	207.47	208.53	209.58	210.64	211.71	212.78	213.85	214.92
6.0	216.00	217.08	218.17	219.26	220.35	221.45	222.55	223.65	224.76	225.87
6.1	226.98	228.10	229.22	230.35	231.48	232.61	233.74	234.89	236.03	237.18
6.2	238.33	239.48	240.64	241.80	242.97	244.14	245.31	246.49	247.67	248.86
6.3	250.05	251.24	252.44	253.64	254.84	256.05	257.26	258.47	259.69	260.92
6.4	262.14	263.37	264.61	265.85	267.09	268.34	269.59	270.84	272.10	273.36
6.5	274.63	275.89	277.17	278.45	279.73	281.01	282.30	283.59	284.89	286.19
6.6	288.50	288.80	290.12	291.43	292.75	294.08	295.41	296.74	298.08	299.42
6.7	300.76	302.11	303.46	304.82	306.18	307.55	308.92	310.29	311.67	313.08
6.8	314.43	315.82	317.21	318.61	320.01	321.42	322.83	324.24	325.66	327.08
6.9	328.51	329.94	331.37	332.81	334.26	335.70	337.15	338.61	340.07	341.53
7.0	343.00	344.47	345.95	347.43	348.91	350.40	351.90	353.39	354.89	356.40
7.1	357.91	359.43	360.94	362.47	363.99	365.53	367.06	368.60	370.15	371.69
7.2	373.25	374.81	376.37	377.93	379.50	381.08	382.66	384.24	385.83	387.42
7.3	389.02	390.62	392.22	393.83	395.45	397.07	398.69	400.32	401.95	403.58
7.4	405.22	406.87	408.52	410.17	411.83	413.49	415.16	416.83	418.51	420.19
7.5	421.88	423.56	425.26	426.96	428.66	430.37	432.08	433.80	435.52	437.25
7.6	438.98	440.71	442.45	444.19	445.94	447.70	449.46	451.22	452.98	454.76

	0	1	2	3	4	5	6	7	8	9
7.7	456.53	458.31	460.10	461.89	463.68	465.48	467.29	469.10	470.91	472.73
7.8	474.55	476.38	478.21	480.05	481.89	483.74	485.59	487.44	489.30	491.17
7.9	493.04	494.91	496.79	498.68	500.57	502.46	504.36	506.26	508.17	510.08
8.0	512.00	513.92	515.85	517.78	519.72	521.66	523.61	525.56	527.51	529.48
8.1	531.44	533.41	535.39	537.37	539.35	541.34	543.34	545.34	547.34	549.35
8.2	551.37	553.39	555.41	557.44	559.48	561.52	563.56	565.61	567.66	569.72
8.3	571.79	573.86	575.93	578.01	580.09	582.18	584.28	586.38	588.48	590.59
8.4	592.70	594.82	596.95	599.08	601.21	603.35	605.50	607.65	609.80	611.96
8.5	614.12	616.30	618.47	620.65	622.84	625.03	627.22	629.42	631.63	633.84
8.6	636.06	638.28	640.50	642.74	644.97	647.21	649.46	651.71	653.97	656.23
8.7	658.50	660.78	663.05	665.34	667.63	669.92	672.22	674.53	676.84	679.15
8.8	681.47	683.80	686.13	688.47	690.81	693.15	695.51	697.86	700.23	702.60
8.9	704.97	707.35	709.73	712.12	714.52	716.92	719.32	721.73	724.15	726.57
9.0	729.00	731.43	733.87	736.31	738.76	741.22	743.68	746.14	748.61	751.09
9.1	753.57	756.06	758.55	761.05	763.55	766.06	768.58	771.10	773.62	776.15
9.2	778.69	781.23	783.78	786.33	788.89	791.45	794.02	796.60	799.18	801.77
9.3	804.36	806.95	809.56	812.17	814.78	817.40	820.03	822.66	825.29	827.94
9.4	830.58	833.24	835.90	838.56	841.23	843.91	846.59	849.28	851.97	854.67
9.5	857.38	860.09	862.80	865.52	868.25	870.98	873.72	876.47	879.22	881.97
9.6	884.74	887.50	890.28	893.06	895.84	898.63	901.43	904.23	907.04	909.85
9.7	912.67	915.50	918.33	921.17	924.01	926.86	929.71	932.57	935.44	938.31
9.8	941.19	944.08	946.97	949.86	952.76	955.67	958.59	961.50	964.43	967.36
9.9	970.30	973.24	976.19	979.15	982.11	985.07	988.05	991.03	994.01	997.00
	0	1	2	3	4	5	6	7	8	9

CUBE ROOTS. FROM 1 TO 10

0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
1.0	1.00000	1.00333	1.00666	1.00999	1.01322	1.01644	1.01967	1.02283	1.02600	1.02913	1.03227	1.03541	1.03855	1.04169	1.04483	1.04797	1.05110	1.05523
1.1	1.03233	1.03546	1.03859	1.04172	1.04485	1.04798	1.05107	1.05420	1.05733	1.06046	1.06359	1.06672	1.07000	1.07328	1.07656	1.07984	1.08312	1.08639
1.2	1.06277	1.06589	1.06902	1.07114	1.07426	1.07738	1.08048	1.08359	1.08669	1.09000	1.09331	1.09662	1.10000	1.10338	1.10676	1.11014	1.11352	1.11690
1.3	1.09114	1.09426	1.09738	1.10049	1.10361	1.10673	1.10984	1.11295	1.11606	1.11917	1.12236	1.12555	1.12874	1.13193	1.13512	1.13831	1.14150	1.14469
1.4	1.11877	1.12193	1.12509	1.12825	1.13141	1.13457	1.13763	1.14079	1.14395	1.14712	1.15028	1.15345	1.15662	1.15978	1.16295	1.16612	1.16929	1.17246
1.5	1.14473	1.14787	1.15098	1.15408	1.15719	1.16030	1.16340	1.16649	1.16959	1.17269	1.17579	1.17888	1.18197	1.18506	1.18815	1.19124	1.19433	1.19742
1.6	1.16966	1.17280	1.17595	1.17909	1.18223	1.18537	1.18846	1.19155	1.19464	1.19773	1.20082	1.20391	1.20699	1.21008	1.21317	1.21626	1.21935	1.22244
1.7	1.21664	1.21877	1.22091	1.22305	1.22519	1.22832	1.23143	1.23454	1.23766	1.24077	1.24388	1.24699	1.25010	1.25321	1.25632	1.25943	1.26254	1.26565
1.8	1.25866	1.26079	1.26292	1.26505	1.26718	1.26931	1.27144	1.27357	1.27570	1.27783	1.27996	1.28209	1.28422	1.28635	1.28848	1.29061	1.29274	1.29487
1.9	1.29866	1.30079	1.30292	1.30505	1.30718	1.30931	1.31144	1.31357	1.31570	1.31783	1.31996	1.32209	1.32422	1.32635	1.32848	1.33061	1.33274	1.33487
2.0	1.33899	1.34071	1.34262	1.34444	1.34633	1.34811	1.35009	1.35199	1.35387	1.35576	1.35765	1.35954	1.36142	1.36330	1.36518	1.36696	1.36884	1.37072
2.1	1.38066	1.38266	1.38464	1.38666	1.38867	1.39068	1.39269	1.39469	1.39669	1.39869	1.40069	1.40269	1.40469	1.40669	1.40869	1.41069	1.41269	1.41469
2.2	1.39006	1.39206	1.39398	1.39598	1.39796	1.39993	1.40190	1.40387	1.40584	1.40781	1.40978	1.41175	1.41372	1.41569	1.41766	1.41963	1.42160	1.42357
2.3	1.39200	1.39399	1.39598	1.39797	1.39996	1.40195	1.40392	1.40589	1.40786	1.40983	1.41180	1.41377	1.41574	1.41771	1.41968	1.42165	1.42362	1.42559
2.4	1.39389	1.39407	1.39426	1.39444	1.39463	1.39481	1.39499	1.39517	1.39535	1.39553	1.39571	1.39589	1.39597	1.39605	1.39613	1.39621	1.39629	1.39637
2.5	1.35722	1.35890	1.36068	1.36262	1.36444	1.36622	1.36800	1.37000	1.37195	1.37383	1.37571	1.37759	1.37947	1.38135	1.38323	1.38511	1.38699	1.38887
2.6	1.37511	1.37688	1.37866	1.38033	1.38201	1.38369	1.38536	1.38703	1.38871	1.38939	1.39006	1.39084	1.39162	1.39239	1.39316	1.39393	1.39471	1.39549
2.7	1.39295	1.39492	1.39690	1.39887	1.40085	1.40282	1.40479	1.40676	1.40863	1.41050	1.41247	1.41434	1.41621	1.41808	1.42005	1.42192	1.42379	1.42566
2.8	1.40495	1.41111	1.41218	1.41315	1.41412	1.41509	1.41606	1.41703	1.41799	1.41895	1.41992	1.42089	1.42186	1.42283	1.42380	1.42477	1.42574	1.42671
2.9	1.42260	1.42477	1.42693	1.42899	1.43096	1.43296	1.43493	1.43690	1.43887	1.44084	1.44281	1.44478	1.44675	1.44872	1.45069	1.45266	1.45463	1.45650
3.0	1.44222	1.44339	1.44454	1.44571	1.44686	1.44790	1.44896	1.44991	1.45096	1.45191	1.45296	1.45391	1.45486	1.45581	1.45676	1.45771	1.45866	1.45961
3.1	1.45881	1.45971	1.46112	1.46218	1.46328	1.46438	1.46533	1.46633	1.46734	1.46834	1.46934	1.47034	1.47134	1.47234	1.47334	1.47434	1.47533	1.47630

0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
1.0	1.00000	1.00333	1.00666	1.00999	1.01322	1.01644	1.01967	1.02283	1.02600	1.02913	1.03227	1.03541	1.03855	1.04169	1.04483	1.04797	1.05110	1.05523
1.1	1.03233	1.03546	1.03859	1.04172	1.04485	1.04798	1.05107	1.05420	1.05733	1.06046	1.06359	1.06672	1.07000	1.07328	1.07656	1.08000	1.08333	1.08661
1.2	1.06277	1.06589	1.06902	1.07114	1.07426	1.07738	1.08048	1.08359	1.08669	1.09000	1.09331	1.09662	1.10000	1.10338	1.10676	1.11014	1.11352	1.11690
1.3	1.09114	1.09426	1.09738	1.10049	1.10361	1.10673	1.10984	1.11295	1.11606	1.11917	1.12236	1.12555	1.12874	1.13193	1.13512	1.13831	1.14150	1.14469
1.4	1.11877	1.12193	1.12509	1.12825	1.13144	1.13460	1.13771	1.14086	1.14395	1.14712	1.15028	1.15345	1.15662	1.15979	1.16296	1.16613	1.16930	1.17247
1.5	1.14473	1.14787	1.15098	1.15408	1.15719	1.16020	1.16331	1.16642	1.16953	1.17264	1.17573	1.17882	1.18191	1.18506	1.18815	1.19124	1.19433	1.19742
1.6	1.16966	1.17280	1.17595	1.17909	1.18223	1.18537	1.18846	1.19155	1.19464	1.19773	1.20082	1.20391	1.20699	1.21008	1.21317	1.21626	1.21935	1.22244
1.7	1.21664	1.21877	1.22091	1.22305	1.22519	1.22832	1.23143	1.23454	1.23766	1.24074	1.24383	1.24692	1.25000	1.25309	1.25618	1.25927	1.26236	1.26545
1.8	1.25866	1.26079	1.26292	1.26505	1.26718	1.26931	1.27144	1.27357	1.27570	1.27783	1.28092	1.28301	1.28610	1.28919	1.29227	1.29536	1.29845	1.30153
1.9	1.29866	1.30079	1.30292	1.30505	1.30718	1.30931	1.31144	1.31357	1.31570	1.31783	1.32092	1.32301	1.32610	1.32919	1.33228	1.33537	1.33846	1.34155
2.0	1.33899	1.34071	1.34262	1.34444	1.34633	1.34811	1.35009	1.35199	1.35387	1.35576	1.35765	1.35953	1.36142	1.36330	1.36518	1.36696	1.36884	1.37072
2.1	1.38066	1.38266	1.38464	1.38666	1.38867	1.39068	1.39269	1.39469	1.39669	1.39869	1.40069	1.40269	1.40469	1.40669	1.40869	1.41069	1.41269	1.41469
2.2	1.39006	1.39206	1.39398	1.39598	1.39796	1.39993	1.40190	1.40387	1.40584	1.40781	1.40978	1.41175	1.41372	1.41569	1.41766	1.41963	1.42160	1.42357
2.3	1.39200	1.39399	1.39598	1.39797	1.39996	1.40195	1.40392	1.40589	1.40786	1.40983	1.41180	1.41377	1.41574	1.41771	1.41968	1.42165	1.42362	1.42559
2.4	1.39389	1.39407	1.39426	1.39444	1.39463	1.39481	1.39499	1.39517	1.39535	1.39553	1.39571	1.39589	1.39607	1.39625	1.39643	1.39661	1.39679	1.39697
2.5	1.39576	1.39694	1.39812	1.39930	1.40048	1.40166	1.40284	1.40402	1.40520	1.40638	1.40756	1.40874	1.40992	1.41110	1.41229	1.41347	1.41465	1.41583
2.6	1.40495	1.41111	1.41218	1.41315	1.41412	1.41509	1.41606	1.41703	1.41799	1.41895	1.41992	1.42090	1.42187	1.42284	1.42381	1.42478	1.42575	1.42672
2.7	1.42260	1.42477	1.42693	1.42899	1.43096	1.43296	1.43493	1.43690	1.43887	1.44084	1.44281	1.44478	1.44675	1.44872	1.45069	1.45266	1.45463	1.45660
2.8	1.44222	1.44339	1.44454	1.44571	1.44686	1.44790	1.44896	1.44991	1.45096	1.45191	1.45296	1.45391	1.45486	1.45581	1.45676	1.45771	1.45866	1.45961
2.9	1.45881	1.45971	1.46112	1.46218	1.46328	1.46438	1.46533	1.46633	1.46734	1.46834	1.46934	1.47034	1.47134	1.47234	1.47334	1.47434	1.47533	1.47630
3.0	1.47511	1.47677	1.47822	1.47977	1.48122	1.48278	1.48423	1.48567	1.48713	1.48858	1.48997	1.49139	1.49281	1.49426	1.49569	1.49707	1.49843	1.49979
3.1	1.48886	1.49093	1.49216	1.49333	1.49450	1.49567	1.49683	1.49800	1.49917	1.50032	1.50149	1.50262	1.50371	1.50487	1.50597	1.50707	1.50822	1.50931
3.2	1.49736	1.50366	1.50581	1.50797	1.51010	1.51224	1.51439	1.51656	1.51873	1.52088	1.52305	1.52522	1.52739	1.52956	1.53172	1.53389	1.53507	1.53723
3.3	1.51183	1.51540	1.51917	1.52122	1.52526	1.52941	1.53357	1.53771	1.54186	1.55500	1.55917	1.56334	1.56751	1.57168	1.57581	1.57992	1.58406	1.58819
3.4	1.52326	1.53340	1.53555	1.54171	1.55088	1.55604	1.56220	1.56837	1.57454	1.58083	1.58703	1.59349	1.60006	1.60693	1.61357	1.61919	1.62574	1.63224
3.5	1.54667	1.55619	1.56481	1.56532	1.56546	1.56561	1.56677	1.56795	1.56913	1.56931	1.56949	1.56967	1.56985	1.56993	1.56997	1.57005	1.57013	1.57021
3.6	1.56005	1.56134	1.56147	1.56160	1.56173	1.56185	1.56198	1.56211	1.56223	1.56236	1.56249	1.56262	1.56275	1.56288	1.56297	1.56314	1.56327	1.56340
3.7	1.56287	1.56399	1.56411	1.56424	1.56436	1.56448	1.56461	1.56473	1.56486	1.56499	1.56512	1.56525	1.56538	1.56551	1.5656			

CUBE ROOTS. FROM 1 TO 10

0	1	2	3	4	5	6	7	8	9
0	1	2	3	4	5	6	7	8	9
5.5	1.7662	1.7673	1.7684	1.7694	1.7705	1.7716	1.7726	1.7737	1.7748
5.6	1.7758	1.7769	1.7779	1.7789	1.7790	1.7811	1.7821	1.7842	1.7853
5.7	1.7863	1.7874	1.7884	1.7894	1.7905	1.7915	1.7926	1.7946	1.7957
5.8	1.7967	1.7977	1.7988	1.7998	1.8008	1.8018	1.8029	1.8049	1.8059
5.9	1.8070	1.8090	1.8100	1.8110	1.8121	1.8131	1.8141	1.8161	1.8181
6.0	1.8171	1.8181	1.8191	1.8201	1.8211	1.8222	1.8232	1.8252	1.8262
6.1	1.8272	1.8282	1.8292	1.8302	1.8311	1.8321	1.8331	1.8341	1.8351
6.2	1.8371	1.8381	1.8391	1.8400	1.8410	1.8420	1.8430	1.8440	1.8450
6.3	1.8469	1.8479	1.8489	1.8499	1.8508	1.8518	1.8528	1.8547	1.8557
6.4	1.8566	1.8576	1.8586	1.8595	1.8605	1.8615	1.8624	1.8634	1.8653
6.5	1.8663	1.8672	1.8682	1.8691	1.8701	1.8710	1.8720	1.8739	1.8748
6.6	1.8758	1.8767	1.8777	1.8786	1.8796	1.8805	1.8814	1.8833	1.8843
6.7	1.8852	1.8861	1.8871	1.8880	1.8889	1.8899	1.8908	1.8917	1.8927
6.8	1.8955	1.8964	1.8974	1.8983	1.8992	1.8992	1.9001	1.9019	1.9029
6.9	1.9038	1.9047	1.9056	1.9065	1.9074	1.9084	1.9093	1.9102	1.9111
7.0	1.9129	1.9138	1.9148	1.9157	1.9166	1.9175	1.9184	1.9193	1.9202
7.1	1.9220	1.9229	1.9238	1.9247	1.9256	1.9265	1.9274	1.9283	1.9292
7.2	1.9310	1.9319	1.9328	1.9337	1.9345	1.9354	1.9363	1.9372	1.9381
7.3	1.9399	1.9408	1.9417	1.9425	1.9434	1.9443	1.9452	1.9461	1.9470
7.4	1.9487	1.9496	1.9504	1.9513	1.9522	1.9531	1.9540	1.9548	1.9557
7.5	1.9574	1.9583	1.9592	1.9600	1.9609	1.9618	1.9626	1.9635	1.9644
7.6	1.9661	1.9670	1.9678	1.9687	1.9695	1.9704	1.9713	1.9721	1.9730

7.7	1.9747	1.9755	1.9764	1.9772	1.9781	1.9789	1.9798	1.9806	1.9815
7.8	1.9832	1.9840	1.9849	1.9857	1.9866	1.9874	1.9883	1.9891	1.9899
7.9	1.9916	1.9925	1.9933	1.9941	1.9950	1.9958	1.9967	1.9975	1.9983
8.0	2.0008	2.0008	2.0017	2.0025	2.0033	2.0042	2.0050	2.0058	2.0066
8.1	2.0163	2.0173	2.0182	2.0190	2.0198	2.0206	2.0214	2.0214	2.0214
8.2	2.0247	2.0255	2.0263	2.0271	2.0279	2.0288	2.0296	2.0304	2.0312
8.3	2.0328	2.0336	2.0344	2.0352	2.0360	2.0368	2.0376	2.0384	2.0392
8.4	2.0416	2.0424	2.0432	2.0440	2.0448	2.0456	2.0464	2.0472	2.0480
8.5	2.0408	2.0409	2.0416	2.0424	2.0432	2.0440	2.0448	2.0456	2.0464
8.6	2.0496	2.0497	2.0504	2.0508	2.0512	2.0516	2.0520	2.0524	2.0528
8.7	2.0567	2.0575	2.0582	2.0591	2.0599	2.0606	2.0614	2.0622	2.0630
8.8	2.0646	2.0653	2.0661	2.0669	2.0677	2.0685	2.0692	2.0700	2.0708
8.9	2.0724	2.0731	2.0739	2.0747	2.0755	2.0762	2.0770	2.0778	2.0785
9.0	2.0801	2.0809	2.0816	2.0824	2.0832	2.0839	2.0847	2.0855	2.0862
9.1	2.0878	2.0885	2.0893	2.0901	2.0908	2.0916	2.0923	2.0931	2.0939
9.2	2.0954	2.0961	2.0969	2.0977	2.0984	2.0992	2.0999	2.1007	2.1014
9.3	2.1029	2.1037	2.1045	2.1052	2.1060	2.1067	2.1075	2.1082	2.1090
9.4	2.1112	2.1120	2.1127	2.1134	2.1142	2.1149	2.1157	2.1164	2.1172
9.5	2.1179	2.1187	2.1194	2.1201	2.1209	2.1216	2.1224	2.1231	2.1238
9.6	2.1253	2.1261	2.1268	2.1275	2.1283	2.1290	2.1297	2.1304	2.1312
9.7	2.1327	2.1334	2.1341	2.1349	2.1356	2.1363	2.1371	2.1378	2.1385
9.8	2.1401	2.1407	2.1414	2.1422	2.1429	2.1436	2.1443	2.1451	2.1458
9.9	2.1472	2.1480	2.1487	2.1494	2.1501	2.1508	2.1516	2.1523	2.1530

CUBE ROOTS. FROM 10 TO 100

	• 0	• 1	• 2	• 3	• 4	• 5	• 6	• 7	• 8	• 9	1	2	3	4	5	6	7	8	9
10	2.1544	2.1616	2.1687	2.1757	2.1828	2.1898	2.1967	2.2036	2.2104	2.2172	7	14	21	28	35	42	49	56	62
11	2.2240	2.2307	2.2374	2.2440	2.2506	2.2571	2.2637	2.2702	2.2766	2.2831	7	13	20	26	33	39	46	52	59
12	2.2894	2.2958	2.3021	2.3084	2.3146	2.3195	2.3257	2.3320	2.3381	2.3453	6	12	18	24	30	37	43	50	55
13	2.3513	2.3573	2.3633	2.3693	2.3752	2.3811	2.3870	2.3928	2.3986	2.4044	6	12	18	23	29	35	41	47	53
14	2.4101	2.4159	2.4216	2.4272	2.4329	2.4385	2.4441	2.4497	2.4552	2.4607	6	11	17	22	28	34	39	45	51
15	2.4662	2.4717	2.4771	2.4825	2.4879	2.4933	2.4987	2.5040	2.5093	2.5146	5	11	16	21	27	32	38	43	48
16	2.5198	2.5251	2.5303	2.5353	2.5385	2.5407	2.5458	2.5502	2.5561	2.5612	5	10	15	20	25	30	35	39	44
17	2.5713	2.5763	2.5813	2.5863	2.5913	2.5962	2.6012	2.6061	2.6110	2.6159	5	10	15	21	26	31	36	41	46
18	2.6207	2.6256	2.6304	2.6352	2.6400	2.6448	2.6495	2.6543	2.6590	2.6637	5	10	14	19	24	29	33	38	43
19	2.6684	2.6731	2.6777	2.6824	2.6870	2.6916	2.6962	2.7008	2.7053	2.7099	5	9	14	18	23	28	32	37	41
20	2.7144	2.7189	2.7234	2.7279	2.7324	2.7369	2.7413	2.7457	2.7501	2.7545	4	9	13	18	22	27	31	36	40
21	2.7589	2.7633	2.7677	2.7720	2.7763	2.7806	2.7849	2.8273	2.8314	2.8356	4	8	13	17	21	26	29	34	38
22	2.8020	2.8063	2.8105	2.8147	2.8189	2.8231	2.8273	2.8314	2.8356	2.8397	4	8	12	16	20	24	28	32	37
23	2.8439	2.8480	2.8521	2.8562	2.8603	2.8643	2.8684	2.8724	2.8765	2.8805	4	8	12	16	20	24	28	32	36
24	2.8845	2.8885	2.8925	2.8965	2.9004	2.9044	2.9083	2.9123	2.9162	2.9201	4	8	12	16	20	24	28	32	36
25	2.9240	2.9279	2.9318	2.9357	2.9395	2.9434	2.9472	2.9511	2.9549	2.9587	4	8	12	15	19	23	27	31	35
26	2.9625	2.9663	2.9701	2.9738	2.9776	2.9814	2.9851	2.9888	2.9926	2.9963	4	8	11	15	18	22	26	29	33
27	3.0009	3.0037	3.0074	3.0111	3.0147	3.0184	3.0221	3.0257	3.0293	3.0330	4	7	11	14	18	21	25	29	32
28	3.0366	3.0402	3.0438	3.0474	3.0510	3.0546	3.0581	3.0617	3.0652	3.0688	4	7	11	14	17	21	24	28	31
29	3.0723	3.0758	3.0794	3.0829	3.0864	3.0909	3.0943	3.0974	3.1003	3.1038	3	7	10	14	17	21	24	28	31
30	3.1072	3.1107	3.1141	3.1176	3.1210	3.1244	3.1278	3.1312	3.1346	3.1380	3	7	10	14	17	21	24	28	31
31	3.1414	3.1448	3.1481	3.1515	3.1548	3.1582	3.1615	3.1648	3.1682	3.1715	3	7	10	13	17	20	23	27	30

	• 0	• 1	• 2	• 3	• 4	• 5	• 6	• 7	• 8	• 9	1	2	3	4	5	6	7	8	9
32	3.1748	3.1781	3.1814	3.1847	3.1880	3.1913	3.1945	3.1978	3.2010	3.2043	3	7	10	13	16	20	23	26	29
33	3.2075	3.2108	3.2140	3.2172	3.2204	3.2237	3.2269	3.2301	3.2334	3.2364	3	6	10	13	16	19	22	26	29
34	3.2296	3.2428	3.2460	3.2491	3.2522	3.2554	3.2586	3.2617	3.2648	3.2679	3	6	10	13	16	19	22	25	28
35	3.2711	3.2742	3.2773	3.2804	3.2835	3.2866	3.2897	3.2927	3.2958	3.2989	3	6	9	12	15	18	22	25	27
36	3.3019	3.3050	3.3080	3.3111	3.3141	3.3171	3.3202	3.3232	3.3262	3.3292	3	6	9	12	15	18	21	24	27
37	3.3322	3.3352	3.3382	3.3412	3.3442	3.3472	3.3501	3.3531	3.3561	3.3590	3	6	9	12	15	18	21	24	27
38	3.3649	3.3679	3.3708	3.3737	3.3767	3.3796	3.3825	3.3854	3.3883	3.3911	3	6	9	12	14	17	20	23	26
39	3.3912	3.3941	3.3970	3.3999	3.4028	3.4056	3.4085	3.4114	3.4142	3.4171	3	6	9	12	14	17	20	23	26
40	3.4220	3.4256	3.4295	3.4331	3.4361	3.4397	3.4430	3.4467	3.4497	3.4526	3	6	9	11	14	17	20	23	25
41	3.4482	3.4510	3.4538	3.4566	3.4594	3.4622	3.4650	3.4677	3.4705	3.4733	3	6	8	11	14	17	19	22	25
42	3.4760	3.4788	3.4815	3.4843	3.4870	3.4898	3.4925	3.4952	3.4980	3.5007	3	5	8	11	14	16	19	22	25
43	3.5034	3.5061	3.5088	3.5115	3.5142	3.5169	3.5202	3.5223	3.5250	3.5277	3	5	8	11	13	16	19	22	24
44	3.5330	3.5353	3.5377	3.5394	3.5410	3.5437	3.5463	3.5490	3.5516	3.5543	3	5	8	11	13	16	19	21	24
45	3.5569	3.5595	3.5622	3.5648	3.5674	3.5700	3.5726	3.5752	3.5778	3.5805	3	5	8	10	13	16	18	21	23
46	3.5830	3.5856	3.5882	3.5908	3.5934	3.5960	3.5986	3.6011	3.6037	3.6063	3	5	8	10	13	15	18	21	23
47	3.6088	3.6114	3.6139	3.6165	3.6190	3.6216	3.6241	3.6267	3.6292	3.6317	3	5	8	10	13	15	18	20	22
48	3.6342	3.6368	3.6393	3.6418	3.6443	3.6468	3.6493	3.6518	3.6543	3.6568	3	5	8	10	13	15	18	20	22
49	3.6593	3.6618	3.6643	3.6668	3.6692	3.6717	3.6742	3.6766	3.6791	3.6816	2	5	7	10	12	15	17	20	22
50	3.6840	3.6865	3.6889	3.6914	3.6938	3.6963	3.6987	3.7011	3.7036	3.7060	2	5	7	10	12	15	17	20	22
51	3.7084	3.7109	3.7133	3.7157	3.7181	3.7205	3.7229	3.7253	3.7277	3.7301	2	5	7	10	12	14	17	19	22
52	3.7225	3.7349	3.7373	3.7397	3.7421	3.7444	3.7468	3.7492	3.7516	3.7539	2	5	7	10	12	14	17	19	22
53	3.7363	3.7586	3.7610	3.7634	3.7657	3.7681	3.7704	3.7728	3.7751	3.7774	2	5	7	9	12	14	16	19	21
54	3.7798	3.7821	3.7844	3.7868	3.7891	3.7914	3.7937	3.7960	3.7983	3.8006	2	5	7	9	12	14	16	19	21

CUBE ROOTS. FROM 10 TO 100

0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9
55	3.8030	3.8053	3.8076	3.8099	3.8121	3.8144	3.8167	3.8190	3.8213	3.8236	2	5	7	9	11	14	16	18	21
56	3.8259	3.8281	3.8304	3.8327	3.8350	3.8372	3.8395	3.8417	3.8440	3.8463	2	5	7	9	11	14	16	18	20
57	3.8485	3.8508	3.8530	3.8552	3.8575	3.8597	3.8620	3.8642	3.8664	3.8686	2	4	7	9	11	13	15	18	20
58	3.8709	3.8731	3.8753	3.8775	3.8798	3.8820	3.8842	3.8864	3.8886	3.8908	2	4	7	9	11	13	15	18	20
59	3.8930	3.8952	3.8974	3.8996	3.9018	3.9040	3.9061	3.9083	3.9105	3.9127	2	4	7	9	11	13	15	18	20
60	3.9149	3.9170	3.9192	3.9214	3.9235	3.9257	3.9279	3.9300	3.9322	3.9343	2	4	6	9	11	13	15	17	19
61	3.9365	3.9386	3.9408	3.9429	3.9451	3.9472	3.9494	3.9515	3.9536	3.9558	2	4	6	9	11	13	15	17	19
62	3.9621	3.9643	3.9664	3.9685	3.9706	3.9727	3.9748	3.9767	3.9788	3.9908	2	4	6	8	10	13	15	17	19
63	3.9791	3.9812	3.9833	3.9854	3.9875	3.9895	3.9916	3.9937	3.9958	3.9979	2	4	6	8	10	12	14	16	18
64	4.0000	4.0021	4.0042	4.0062	4.0083	4.0104	4.0125	4.0145	4.0166	4.0187	2	4	6	8	10	12	14	16	18
65	4.0207	4.0228	4.0248	4.0269	4.0290	4.0310	4.0331	4.0351	4.0372	4.0392	2	4	6	8	10	12	14	16	18
66	4.0412	4.0433	4.0453	4.0474	4.0494	4.0514	4.0535	4.0555	4.0575	4.0595	2	4	6	8	10	12	14	16	18
67	4.0615	4.0636	4.0656	4.0676	4.0696	4.0716	4.0736	4.0756	4.0777	4.0797	2	4	6	8	10	12	14	16	18
68	4.0817	4.0837	4.0857	4.0877	4.0896	4.0916	4.0936	4.0956	4.0976	4.0996	2	4	6	8	10	12	14	16	18
69	4.1016	4.1035	4.1055	4.1075	4.1095	4.1115	4.1134	4.1154	4.1174	4.1193	2	4	6	8	10	12	14	16	18
70	4.1213	4.1232	4.1252	4.1272	4.1291	4.1311	4.1330	4.1350	4.1370	4.1389	2	4	6	8	10	12	14	16	18
71	4.1408	4.1428	4.1447	4.1466	4.1486	4.1505	4.1524	4.1544	4.1563	4.1582	2	4	6	8	10	12	14	16	17
72	4.1602	4.1621	4.1640	4.1659	4.1679	4.1698	4.1717	4.1736	4.1755	4.1774	2	4	6	8	10	12	14	16	17
73	4.1793	4.1812	4.1832	4.1851	4.1870	4.1889	4.1908	4.1927	4.1946	4.1964	2	4	6	8	10	12	14	15	17
74	4.1983	4.2002	4.2021	4.2040	4.2059	4.2078	4.2097	4.2115	4.2134	4.2153	2	4	6	8	9	11	13	15	17
75	4.2172	4.2190	4.2209	4.2228	4.2246	4.2265	4.2284	4.2302	4.2321	4.2340	2	4	6	7	9	11	13	15	17
76	4.2358	4.2377	4.2395	4.2414	4.2432	4.2451	4.2469	4.2488	4.2506	4.2525	2	4	6	7	9	11	13	15	17

77	4.2543	4.2562	4.2580	4.2598	4.2617	4.2635	4.2653	4.2672	4.2690	4.2708	2	4	6	7	9	11	13	15	17
78	4.2727	4.2745	4.2763	4.2781	4.2799	4.2818	4.2836	4.2854	4.2872	4.2890	2	4	5	7	9	11	13	14	16
79	4.2908	4.2927	4.2945	4.2963	4.2981	4.2999	4.3017	4.3035	4.3053	4.3071	2	4	5	7	9	11	13	14	16
80	4.3089	4.3107	4.3125	4.3143	4.3160	4.3178	4.3196	4.3214	4.3232	4.3250	2	4	5	7	9	11	13	14	16
81	4.3267	4.3285	4.3303	4.3321	4.3339	4.3354	4.3371	4.3389	4.3409	4.3427	2	4	5	7	9	11	12	14	16
82	4.3445	4.3462	4.3480	4.3498	4.3515	4.3533	4.3551	4.3568	4.3586	4.3603	2	4	5	7	9	11	12	14	16
83	4.3621	4.3638	4.3656	4.3673	4.3691	4.3708	4.3726	4.3743	4.3760	4.3778	2	3	5	7	9	10	12	14	16
84	4.3795	4.3813	4.3830	4.3847	4.3865	4.3882	4.3899	4.3917	4.3934	4.3951	2	3	5	7	9	10	12	14	16
85	4.3968	4.3986	4.4003	4.4020	4.4037	4.4054	4.4072	4.4089	4.4106	4.4123	2	3	5	7	9	10	12	14	16
86	4.4140	4.4157	4.4174	4.4208	4.4225	4.4242	4.4259	4.4276	4.4293	4.4310	2	3	5	7	9	10	12	14	15
87	4.4310	4.4327	4.4344	4.4361	4.4378	4.4395	4.4412	4.4429	4.4446	4.4462	2	3	5	7	9	10	12	14	15
88	4.4480	4.4496	4.4513	4.4530	4.4547	4.4564	4.4580	4.4597	4.4614	4.4631	2	3	5	7	8	10	12	13	15
89	4.4647	4.4664	4.4681	4.4698	4.4714	4.4731	4.4748	4.4764	4.4781	4.4797	2	3	5	7	8	10	12	13	15
90	4.4814	4.4831	4.4847	4.4864	4.4880	4.4897	4.4913	4.4930	4.4946	4.4963	2	3	5	7	8	10	12	13	15
91	4.4979	4.4996	4.5012	4.5029	4.5045	4.5062	4.5078	4.5094	4.5111	4.5127	2	3	5	7	8	10	12	13	15
92	4.5144	4.5160	4.5176	4.5193	4.5209	4.5225	4.5242	4.5258	4.5274	4.5290	2	3	5	7	8	10	11	13	15
93	4.5307	4.5323	4.5339	4.5355	4.5371	4.5388	4.5404	4.5420	4.5436	4.5452	2	3	5	6	8	10	11	13	14
94	4.5468	4.5484	4.5501	4.5517	4.5533	4.5549	4.5565	4.5581	4.5597	4.5613	2	3	5	6	8	10	11	13	14
95	4.5629	4.5645	4.5661	4.5677	4.5693	4.5709	4.5725	4.5741	4.5757	4.5773	2	3	5	6	8	10	11	13	14
96	4.5779	4.5804	4.5820	4.5836	4.5852	4.5868	4.5884	4.5899	4.5915	4.5931	2	3	5	6	8	9	11	13	14
97	4.5947	4.5963	4.5979	4.5994	4.6010	4.6026	4.6042	4.6057	4.6073	4.6089	2	3	5	6	8	9	11	13	14
98	4.6104	4.6120	4.6136	4.6151	4.6167	4.6183	4.6198	4.6214	4.6239	4.6245	2	3	5	6	8	9	11	13	14
99	4.6261	4.6276	4.6292	4.6307	4.6323	4.6338	4.6354	4.6369	4.6385	4.6400	2	3	5	6	8	9	11	12	14

CUBE ROOTS. FROM 100 TO 1000

0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
10	4.6416	4.6723	4.6875	4.7027	4.7177	4.7326	4.7475	4.7622	4.7769	15	30	45	60	75	90	105	120	135
11	4.7914	4.8203	4.8346	4.8488	4.8629	4.8770	4.8910	4.9049	4.9187	14	28	42	56	71	85	99	113	127
12	4.9324	4.9461	4.9597	4.9732	4.9866	5.0000	5.0133	5.0265	5.0397	13	27	40	53	67	80	93	106	120
13	5.0658	5.0788	5.0916	5.1045	5.1172	5.1299	5.1426	5.1551	5.1676	5.1801	13	25	38	51	64	76	89	102
14	5.1925	5.2048	5.2171	5.2293	5.2415	5.2536	5.2656	5.2776	5.2896	5.3015	12	24	36	48	61	73	85	97
15	5.3133	5.3251	5.3368	5.3485	5.3601	5.3717	5.3832	5.3947	5.4061	5.4175	12	23	35	46	58	70	81	93
16	5.4288	5.4401	5.4514	5.4626	5.4737	5.4848	5.4959	5.5069	5.5178	5.5289	11	22	33	44	56	67	78	89
17	5.5397	5.5565	5.5613	5.5671	5.5721	5.5828	5.5934	5.6041	5.6147	5.6252	5.6357	11	21	31	43	54	64	75
18	5.6462	5.6567	5.6671	5.6774	5.6877	5.6980	5.7083	5.7183	5.7287	5.7388	10	21	31	41	52	62	72	82
19	5.7489	5.7590	5.7690	5.7790	5.7890	5.7989	5.8088	5.8186	5.8285	5.8383	10	20	30	40	50	59	69	79
20	5.8480	5.8578	5.8675	5.8771	5.8868	5.8964	5.9059	5.9155	5.9250	5.9345	10	19	29	38	48	58	67	77
21	5.9439	5.9533	5.9627	5.9721	5.9814	5.9907	6.0000	6.0092	6.0185	6.0277	9	19	28	37	47	56	65	74
22	6.0368	6.0459	6.0550	6.0641	6.0732	6.0822	6.0912	6.1002	6.1091	6.1180	6.1271	9	18	27	36	45	54	63
23	6.1269	6.1358	6.1446	6.1534	6.1622	6.1710	6.1797	6.1885	6.1972	6.2058	9	18	26	35	44	53	62	70
24	6.2145	6.2231	6.2317	6.2403	6.2488	6.2573	6.2658	6.2743	6.2828	6.2912	9	17	26	34	43	51	60	68
25	6.2996	6.3080	6.3164	6.3247	6.3330	6.3413	6.3496	6.3579	6.3661	6.3743	8	17	25	33	42	50	58	66
26	6.3825	6.3907	6.3988	6.4070	6.4151	6.4232	6.4312	6.4393	6.4473	6.4553	8	16	24	32	41	49	57	65
27	6.4633	6.4713	6.4792	6.4872	6.4951	6.5032	6.5108	6.5187	6.5265	6.5343	8	15	23	31	39	46	54	62
28	6.5421	6.5499	6.5577	6.5654	6.5731	6.5808	6.5885	6.5962	6.6039	6.6115	8	15	23	30	38	45	53	60
29	6.6191	6.6267	6.6343	6.6419	6.6494	6.6569	6.6644	6.6719	6.6794	6.6869	8	15	23	30	37	44	52	59
30	6.6943	6.7018	6.7092	6.7166	6.7240	6.7313	6.7387	6.7460	6.7533	6.7606	7	15	22	30	37	44	52	59
31	6.7679	6.7732	6.7824	6.7897	6.7989	6.8041	6.8113	6.8185	6.8256	6.8328	7	14	22	29	36	43	50	58

0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9
32	6.8399	6.8470	6.8541	6.8612	6.8683	6.8753	6.8824	6.8894	6.8964	6.9034	7	14	21	28	36	43	50	57
33	6.9104	6.9174	6.9244	6.9313	6.9382	6.9451	6.9521	6.9589	6.9658	6.9727	7	14	21	28	35	41	48	55
34	6.9795	6.9864	6.9932	7.0000	7.0068	7.0136	7.0203	7.0271	7.0338	7.0406	7	14	20	27	34	41	48	54
35	7.0473	7.0540	7.0607	7.0674	7.0740	7.0807	7.0873	7.0940	7.1006	7.1072	7	13	20	27	34	40	47	54
36	7.1138	7.1204	7.1269	7.1335	7.1400	7.1466	7.1531	7.1596	7.1661	7.1726	7	13	20	26	33	39	46	52
37	7.1791	7.1855	7.1920	7.1984	7.2048	7.2112	7.2177	7.2240	7.2304	7.2368	7	13	19	26	32	38	45	51
38	7.2432	7.2495	7.2558	7.2622	7.2685	7.2748	7.2811	7.2874	7.2936	7.2997	7	13	19	25	32	38	44	50
39	7.3061	7.3124	7.3186	7.3248	7.3310	7.3372	7.3434	7.3496	7.3558	7.3619	6	12	19	25	31	37	43	50
40	7.3683	7.3742	7.3803	7.3864	7.3925	7.3986	7.4047	7.4108	7.4169	7.4229	6	12	18	24	31	37	43	49
41	7.4290	7.4350	7.4410	7.4470	7.4530	7.4590	7.4650	7.4710	7.4770	7.4829	6	12	18	24	30	36	42	48
42	7.4889	7.4948	7.5007	7.5067	7.5126	7.5185	7.5244	7.5302	7.5361	7.5420	6	12	17	23	29	35	41	47
43	7.5478	7.5537	7.5595	7.5654	7.5714	7.5773	7.5832	7.5891	7.5944	7.6001	6	12	17	23	29	35	41	47
44	7.6059	7.6117	7.6174	7.6232	7.6289	7.6346	7.6403	7.6460	7.6517	7.6574	6	11	17	23	29	34	40	46
45	7.6631	7.6688	7.6744	7.6801	7.6857	7.6914	7.6970	7.7026	7.7082	7.7138	6	11	17	22	28	34	39	45
46	7.7194	7.7250	7.7306	7.7362	7.7418	7.7473	7.7529	7.7584	7.7639	7.7695	6	11	17	22	28	34	39	45
47	7.7750	7.7805	7.7860	7.7915	7.7970	7.8025	7.8079	7.8134	7.8188	7.8243	6	11	17	22	28	33	39	44
48	7.8297	7.8352	7.8406	7.8460	7.8514	7.8568	7.8622	7.8676	7.8730	7.8784	6	11	16	22	27	32	38	43
49	7.8837	7.8891	7.8944	7.8998	7.9051	7.9105	7.9158	7.9211	7.9264	7.9317	5	11	16	21	27	32	37	42
50	7.9370	7.9423	7.9476	7.9528	7.9581	7.9634	7.9686	7.9739	7.9791	7.9843	5	11	16	21	27	32	37	42
51	7.9896	7.9948	8.0000	8.0052	8.0104	8.0156	8.0208	8.0260	8.0311	8.0363	5	10	16	21	26	31	36	42
52	8.0415	8.0466	8.0517	8.0569	8.0671	8.0723	8.0774	8.0825	8.0876	8.0925	5	10	15	20	26	31	36	41
53	8.0937	8.0978	8.1028	8.1079	8.1130	8.1180	8.1231	8.1281	8.1332	8.1382	5	10	15	20	25	30	35	40
54	8.1433	8.1483	8.1533	8.1583	8.1633	8.1683	8.1733	8.1783	8.1833	8.1882	5	10	15	20	25	30	35	40
55	0	1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8

CUBE ROOTS. FROM 100 TO 1000

0	1	2	3	4	5	6	7	8	9	1-2-3	4-5-6	7-8-9		
55	8-1932	8-1982	8-2031	8-2130	8-2180	8-2229	8-2278	8-2327	8-2377	5-10-15	20-25-29	34-39-44		
56	8-2426	8-2475	8-2524	8-2573	8-2621	8-2670	8-2719	8-2768	8-2816	8-2865	5-10-15	20-25-29	34-39-44	
57	8-2913	8-2962	8-3010	8-3059	8-3107	8-3155	8-3203	8-3251	8-3300	8-3348	5-10-14	19-24-29	34-38-43	
58	8-3396	8-3443	8-3491	8-3539	8-3587	8-3634	8-3682	8-3730	8-3777	8-3825	5-9-14	19-24-28	33-38-42	
59	8-3872	8-3919	8-3967	8-4014	8-4061	8-4108	8-4155	8-4202	8-4249	8-4296	5-9-14	19-24-28	33-38-42	
60	8-4343	8-4390	8-4437	8-4484	8-4530	8-4577	8-4623	8-4670	8-4716	8-4763	5-9-14	19-24-28	33-38-42	
61	8-4809	8-4856	8-4906	8-4948	8-4994	8-5040	8-5086	8-5132	8-5178	8-5224	5-9-14	18-23-28	32-37-41	
62	8-5270	8-5316	8-5362	8-5408	8-5453	8-5499	8-5544	8-5590	8-5635	8-5681	5-9-14	18-23-27	32-36-41	
63	8-5726	8-5772	8-6222	8-6267	8-6312	8-6357	8-6401	8-6446	8-6490	8-6535	8-6579	5-9-14	18-23-27	32-36-41
64	8-6177	8-6222	8-6277	8-6322	8-6377	8-6432	8-6487	8-6541	8-6595	8-6649	8-6693	5-9-14	18-23-27	32-36-41
65	8-6624	8-6668	8-6713	8-6757	8-6801	8-6845	8-6890	8-6934	8-6978	8-7022	4-9-13	18-22-26	31-35-40	
66	8-7006	8-7100	8-7154	8-7198	8-7241	8-7285	8-7329	8-7373	8-7416	8-7460	4-9-13	18-22-26	31-35-40	
67	8-7503	8-7547	8-7590	8-7634	8-7677	8-7721	8-7764	8-7807	8-7850	8-7893	4-9-13	17-22-26	30-34-39	
68	8-8366	8-8408	8-8451	8-8493	8-8536	8-8578	8-8621	8-8663	8-8706	8-8748	4-9-13	17-21-25	30-34-38	
69	8-8790	8-8833	8-8875	8-8917	8-8959	8-9001	8-9043	8-9085	8-9127	8-9169	4-8-13	17-21-25	30-34-38	
70	71	8-9211	8-9253	8-9295	8-9337	8-9378	8-9420	8-9462	8-9503	8-9543	8-9587	4-8-12	17-21-25	29-33-38
72	8-9628	8-9670	8-9711	8-9752	8-9794	8-9835	8-9876	8-9918	8-9959	9-0000	4-8-12	16-21-25	29-33-37	
73	9-0041	9-0082	9-0123	9-0164	9-0202	9-0246	9-0287	9-0328	9-0369	9-0410	4-8-12	16-20-24	28-32-37	
74	9-0450	9-0491	9-0532	9-0572	9-0613	9-0654	9-0694	9-0735	9-0775	9-0816	4-8-12	16-20-24	28-32-37	
75	9-0856	9-0896	9-0937	9-0977	9-1017	9-1057	9-1098	9-1138	9-1178	9-1218	4-8-12	16-20-24	28-32-36	
76	9-1258	9-1298	9-1338	9-1378	9-1418	9-1458	9-1498	9-1537	9-1577	9-1617	4-8-12	16-20-24	28-32-36	

0	1	2	3	4	5	6	7	8	9	1-2-3	4-5-6	7-8-9
77	9-1657	9-1696	9-1736	9-1775	9-1815	9-1855	9-1894	9-1933	9-1973	9-2012	4-8-12	16-20-24
78	9-2052	9-2091	9-2130	9-2170	9-2209	9-2248	9-2287	9-2326	9-2365	9-2404	4-8-12	16-20-24
79	9-2443	9-2482	9-2521	9-2560	9-2599	9-2638	9-2677	9-2716	9-2754	9-2793	4-8-12	16-19-23
80	9-2832	9-2870	9-2909	9-2948	9-2986	9-3025	9-3063	9-3102	9-3140	9-3179	4-8-12	15-19-23
81	9-3217	9-3255	9-3294	9-3332	9-3371	9-3408	9-3447	9-3485	9-3523	9-3561	4-8-11	15-19-23
82	9-3599	9-3637	9-3675	9-3713	9-3751	9-3789	9-3827	9-3865	9-3902	9-3940	4-8-11	15-19-23
83	9-3978	9-4016	9-4053	9-4091	9-4129	9-4166	9-4204	9-4241	9-4279	9-4316	4-8-11	15-19-23
84	9-4354	9-4391	9-4429	9-4466	9-4503	9-4541	9-4578	9-4613	9-4652	9-4690	4-7-11	15-19-22
85	9-4764	9-4801	9-4838	9-4875	9-5012	9-5049	9-5096	9-5133	9-5170	9-5208	4-7-11	15-19-22
86	9-5097	9-5134	9-5171	9-5207	9-5244	9-5281	9-5318	9-5354	9-5391	9-5427	4-7-11	15-18-22
87	9-5464	9-5501	9-5537	9-5574	9-5610	9-5647	9-5683	9-5719	9-5756	9-5792	4-7-11	15-18-22
88	9-5828	9-5865	9-5901	9-5937	9-5973	9-6010	9-6046	9-6082	9-6118	9-6154	4-7-11	14-18-22
89	9-6190	9-6226	9-6262	9-6298	9-6334	9-6370	9-6406	9-6442	9-6477	9-6513	4-7-11	14-18-22
90	9-6549	9-6585	9-6620	9-6656	9-6692	9-6727	9-6763	9-6799	9-6834	9-6870	4-7-11	14-18-21
91	9-6905	9-6941	9-6977	9-7012	9-7047	9-7082	9-7118	9-7153	9-7188	9-7224	4-7-11	14-18-21
92	9-7259	9-7294	9-7329	9-7364	9-7400	9-7435	9-7470	9-7505	9-7540	9-7575	4-7-11	14-18-21
93	9-7610	9-7645	9-7680	9-7715	9-7750	9-7785	9-7819	9-7854	9-7889	9-7924	3-7-10	14-17-21
94	9-7959	9-7993	9-8028	9-8063	9-8097	9-8132	9-8167	9-8201	9-8236	9-8270	3-7-10	14-17-21
95	9-8305	9-8339	9-8374	9-8408	9-8443	9-8477	9-8511	9-8546	9-8580	9-8614	3-7-10	14-17-21
96	9-8648	9-8683	9-8717	9-8751	9-8787	9-8819	9-8854	9-8888	9-8922	9-8956	3-7-10	14-17-20
97	9-8990	9-9024	9-9058	9-9092	9-9126	9-9160	9-9194	9-9227	9-9261	9-9295	3-7-10	14-17-20
98	9-9329	9-9363	9-9396	9-9430	9-9464	9-9497	9-9531	9-9555	9-9586	9-9632	3-7-10	13-17-20
99	9-9666	9-9699	9-9733	9-9766	9-9800	9-9833	9-9866	9-9900	9-9933	9-9967	3-7-10	13-17-20

THE METRIC SYSTEM

MEASURES OF LENGTH

10 millimetres	= 1 centimetre	10 decametres	= 1 hectometre
10 centimetres	= 1 decimetre	10 hectometres	= 1 kilometre
10 decimetres	= 1 metre	10 kilometres	= 1 myriametre
10 metres	= 1 decametre		

MEASURES OF CAPACITY

10 millilitres	= 1 centilitre	10 litres	= 1 decalitre
10 centilitres	= 1 decilitre	10 decalitres	= 1 hectolitre
10 decilitres	= 1 litre	10 hectolitres	= 1 kilolitre

1 litre = 1 cubic decimetre; 1 kilolitre = 1 cubic metre

MEASURES OF WEIGHT

10 milligrammes	= 1 centigramme
10 centigrammes	= 1 decigramme
10 decigrammes	= 1 gramme
10 grammes	= 1 decagramme
10 decagrammes	= 1 hectogramme
10 hectogrammes	= 1 kilogramme
10 kilogrammes	= 1 myriagramme
10 myriagrammes	= 1 quintal
10 quintals	= 1 millier or tonne

MEASURES OF SURFACE

100 square millimetres	= 1 square centimetre
100 square centimetres	= 1 square decimetre
100 square decimetres	= 1 square metre
100 square metres	= 1 square decametre = 1 are
100 square decametres	= 1 square hectometre
100 square hectometres	= 1 square kilometre

10 centiares	= 1 deciare	10 ares	= 1 decare
10 deciares	= 1 are	10 decares	= 1 hectare

CUBIC MEASURE

1000 cubic millimetres	= 1 cubic centimetre
1000 cubic centimetres	= 1 cubic decimetre
1000 cubic decimetres	= 1 cubic metre

CONVERSION TABLES

In the following conversion factors the pound (or gram) is a unit of mass. Where the pound (or gram) is meant as a unit of force the term 'pound weight' (or 'gram weight') is used.

All factors involving the change from the absolute to the gravitational system of units are based on the international standard acceleration due to gravity:

$$g_s = 32.1740 \text{ ft./sec.}^2 = 980.665 \text{ cm./sec.}^2$$

The dimensions of all quantities are given in terms of the fundamental quantities: mass (M), length (L), time (T).

LENGTH (L)

7.92 inches	= 1 link	5½ yards	= 1 rod, pole or perch
12 inches	= 1 foot	4 poles	= 1 chain
3 feet	= 1 yard	10 chains	= 1 furlong
6 feet	= 1 fathom	8 furlongs	= 1 mile

1 chain	= 22 yards	= 100 links
1 mile	= 80 chains	= 1760 yards = 5280 feet
1 nautical mile	= 1.151 miles	= 6080 feet

1 inch	= 25.40 millimetres	1 millimetre	= 0.03937 inch
1 foot	= 30.48 centimetres	1 centimetre	= 0.03281 foot
1 yard	= 0.9144 metre	1 metre	= 39.37 inches
1 chain	= 20.12 metres	1 metre	= 1.094 yards
1 mile	= 1.609 kilometres	1 kilometre	= 0.6214 mile

1 nautical mile	= 1.853 kilometres
1 fathom	= 1.8288 metres

CONVERSION TABLES (continued)

VOLUME (L^3)

4 gills	= 1 pint	4 quarts	= 1 Imp. gallon
2 pints	= 1 quart	6.299 Imp. gallons	= 1 cu. foot
1 cu. foot	= 1,728 cu. inches	= 0.7787 bushel	
1 cu. yard	= 46,656 cu. inches	= 21.03 bushels	
1 shipping ton	= 40 cu. feet of merchandise		
1 shipping ton	= 42 cu. feet of timber		
1 standard of timber	= 165 cu. feet		
1 Imperial gallon	= 277.4 cu. inches	= 0.1605 cu. foot	
1 U.S. gallon	= 231.0 cu. inches	= 0.1337 cu. foot	
1 litre	= 61.02 cu. inches	= 0.03532 cu. foot	
1 cu. inch	= 16.39 cu. cms.		
1 cu. foot	= 0.02832 cu. metre		
1 cu. yard	= 0.7646 cu. metre		
1 pint	= 0.5683 litre		
1 Imperial gallon	= 4.546 litres		
1 cu. foot	= 28.32 litres		
1 Imperial gallon	= 1.201 U.S. gallons		
1 cu. cm.	= 0.06102 cu. inch		
1 cu. metre	= 35.32 cu. feet		
1 cu. metre	= 1.308 cu. yards		
1 litre	= 1.000 cu. cm.		
1 litre	= 0.2200 Imperial gallon		
1 litre	= 0.03532 cu. foot		
1 U.S. gallon	= 0.8327 Imperial gallon		

AREA (L^2)

144 sq. inches	= 1 sq. foot	4840 sq. yards	= 1 acre
9 sq. feet	= 1 sq. yard	640 acres	= 1 sq. mile
1 acre	= 10 sq. chains	= 160 sq. rods	= 43,560 sq. feet

1 acre = 160 sq. rods = 43,560 sq. feet = 100,000 sq. links

1 square of flooring or roofing = 100 sq. feet

1 sq. inch	= 6.452 sq. centimetres
1 sq. foot	= 929.0 sq. centimetres
1 sq. yard	= 0.8361 sq. metre
1 acre	= 40.47 ares
1 sq. mile	= 259.0 hectares
1 sq. centimetre	= 0.1550 sq. inch
1 sq. metre	= 10.76 sq. feet
1 sq. metre	= 1.196 sq. yards
1 hectare	= 2.471 acres
1 hectare	= 0.003861 sq. mile

1 hectare = 100 ares = 10,000 sq. metres

CONVERSION TABLES (continued)

MASS (M)

(All English units are Avoirdupois)

27.34 grains	= 1 dram	28 pounds	= 1 quarter
16 drams	= 1 ounce	4 quarters	= 1 cwt.
16 ounces	= 1 pound	20 cwt.	= 1 ton
7000 grains	= 1 pound	112 pounds	= 1 cwt.
14 pounds	= 1 stone	2240 pounds	= 1 ton
1 grain	= 0.0648 gram	1 milligram	= 0.01543 grain
1 dram	= 1.772 grams	1 gram	= 15.43 grains
1 ounce	= 28.35 grams	1 gram	= 0.03527 ounce
1 pound	= 0.4536 kilograms	1 kilogram	= 2.205 pounds
1 cwt.	= 50.80 kilograms	1 kilogram	= 0.01968 cwt.
1 ton	= 1,016 tonnes	1 tonne	= 0.9842 ton

1 tonne (metric ton)	= 10 quintals	= 1000 kilograms
1 U.S. long ton	= 2240 pounds	= 1 English ton
1 U.S. short ton	= 2000 pounds	= 0.8929 English ton
1 U.S. kip	= 1000 pounds	= 0.4465 English ton
1 U.S. cwt.	= 100 pounds	= 0.8929 English cwt.

LINEAR VELOCITY ($\frac{L}{T}$)

1 m.p.h.	= 88 feet/min.	1 foot/min.	= 0.01136 m.p.h.
1 m.p.h.	= 1.467 feet/sec.	1 foot/sec.	= 0.6817 m.p.h.
1 m.p.h.	= 0.4470 metre/sec.	1 metre/sec.	= 2.237 m.p.h.
1 foot/min.	= 0.5080 cm./sec.	1 cm./sec.	= 1.967 feet/min.

DENSITY ($\frac{M}{L^3}$)

1 lb./cu. in.	= 27.68 g./cu. cm.
1 lb./cu. ft.	= 16.02 kg./cu. m.
1 lb./cu. yd.	= 0.5930 kg./cu. m.
1 ton/cu. yd.	= 1.328 tonnes/cu. m
1 grain/gal.	= 0.01425 g./litre
1 part/100,000	= 0.7017 grain/gal.
1 part/million (p.p.m.)	= 0.07017 grain/gal.
1 g./cu. cm.	= 0.03613 lb./cu. in.
1 kg./cu. m.	= 0.06243 lb./cu. ft.
1 kg./cu. m.	= 1.686 lb./cu. yd.
1 tonne/cu. m.	= 0.7532 ton/cu. yd.
1 g./litre	= 70.17 grains/gal.
1 grain/gal.	= 1.425 parts/100,000
1 grain/gal.	= 14.25 parts/million

CONVERSION TABLES (continued)

POWER CONVERSION FACTORS ($\frac{ML^2}{T^2}$)

(In this table, pound means pound weight and kilogram means kilogram weight)

	Horse power	Metric horse power	Kilowatt	Foot-pound/second	Kg.-metre/second	B.Th.U./hour	Kilo-calorie/hour
Horse power	1	1.014	0.7457	550	76.04	2545	641.3
Metric horse power	0.9863	1	0.7355	542.5	75	2510	632.6
Kilowatt	1.341	1.36	1	737.6	102	3413	860
Foot-pound/second	0.001818	0.001843	0.001356	1	0.1383	4.627	1.166
Kg.-metre/second	0.01315	0.01333	0.009807	7.233	1	33.47	8.433
B.Th.U./hour	0.0003929	0.0003984	0.000293	0.2161	0.07988	1	0.252
Kilo-calorie/hour	0.001559	0.001581	0.001163	0.8576	0.1186	3.968	1

Evaporation of 1 lb. of steam per hour from and at 212° F.

= 970.6 B.Th.U./hour = 0.3815 H.P.

The Metric Horse Power is also known as the Cheval Vapeur, Force de Cheval, or Pferdekraft.

CONVERSION TABLES (continued)

HEAT AND WORK CONVERSION FACTORS ($\frac{ML^2}{T^2}$)

(In this table, pound means pound weight and kilogram means kilogram weight)

	B.Th.U.	C.H.U.	Kilogram-calorie	Foot-pound	Kilogram-metre	Joule	kWh
B.Th.U.	1	0.5555	0.252	778	107.6	1055	0.000293
C.H.U.	1.8	1	0.4536	1400	193.6	1899	0.0005274
Kilogram-calorie	3.968	2.205	1	3087	426.8	4186	0.001163
Foot-pound	0.001285	0.0007141	0.0003239	1	0.1383	1.356	3.767×10^{-7}
Kilogram-metre	0.009297	0.005165	0.002343	7.233	1	9.81	2.724×10^{-6}
Joule	0.000948	0.0005266	0.0002389	0.7375	0.1019	1	2.778×10^{-7}
kWh	3413	1896	860	2,656,000	367,100	3,600,000	1

1 Therm = 100,000 B.Th.U. 1 Joule = 1 Watt-second = 10^7 Ergs. 1 Erg = 1 Dyne-centimetre.

CONVERSION TABLES (continued)

PRESSURE CONVERSION FACTORS $\left(\frac{M}{LT^2}\right)$

(In this table, pound means pound weight and kilogram means kilogram weight)

	Lb./sq. in.	Lb./sq. ft.	Standard atmosphere	Ft. head of water at 62° F.	In. head of water at 62° F.	In. head of mercury at 32° F.	Kg./sq. cm.
Lb./sq. in.	1	144	0-06805	2-312	27-74	2-036	0-07031
Lb./sq. ft.	0-006944	1	0-0004726	0-01605	0-1926	0-01414	0-0004882
Standard atmosphere	14-696	2116	1	33-95	407-4	29-92	1-033
Ft. head of water at 62° F.	0-4325	62-29	0-02944	1	12	0-8806	0-03042
In. head of water at 62° F.	0-03604	5-191	0-002451	0-0833	1	0-07338	0-002535
In. head of mercury at 32° F.	0-4912	70-73	0-03342	1-135	13-62	1	0-03453
Kg./sq. cm.	14-22	2048	0-9678	32-87	394-4	28-96	1

1 Standard Atmosphere = Pressure of 76 cm. column of mercury, density 13-5951 g./c.c., acceleration due to gravity 980-665 cm./sec.²,
= 14-6959 lb./sq. in.

1 Bar = 1000 millibars = 10⁶ dynes/sq. cm. = 14-5 lb./sq. in. = 0-9869 standard atmosphere.

CONVERSION TABLES (continued)

DECIMAL EQUIVALENTS OF FRACTIONS

$\frac{1}{84}$	-01563	$\frac{1}{32}$	-34375	$\frac{17}{48}$	-67188
$\frac{1}{32}$	-03125	$\frac{3}{84}$	-35938	$\frac{11}{48}$	-6875
$\frac{3}{84}$	-04688	$\frac{5}{32}$	-375	$\frac{45}{48}$	-70313
$\frac{1}{16}$	-0625	$\frac{7}{32}$	-39063	$\frac{31}{48}$	-71875
$\frac{5}{84}$	-07813	$\frac{11}{32}$	-40625	$\frac{67}{48}$	-73438
$\frac{3}{16}$	-09375	$\frac{21}{32}$	-42188	$\frac{4}{3}$	-75
$\frac{7}{84}$	-10938	$\frac{7}{16}$	-4375	$\frac{49}{48}$	-76363
$\frac{1}{8}$	-125	$\frac{9}{16}$	-45313	$\frac{15}{48}$	-78125
$\frac{9}{84}$	-14063	$\frac{11}{16}$	-46875	$\frac{51}{48}$	-79688
$\frac{5}{16}$	-15625	$\frac{21}{16}$	-48438	$\frac{13}{48}$	-8125
$\frac{11}{84}$	-17188	$\frac{1}{2}$	-5	$\frac{23}{48}$	-82813
$\frac{3}{8}$	-1875	$\frac{3}{16}$	-51563	$\frac{25}{48}$	-84375
$\frac{13}{84}$	-20313	$\frac{7}{16}$	-53125	$\frac{45}{48}$	-85938
$\frac{7}{16}$	-21875	$\frac{9}{16}$	-54688	$\frac{7}{9}$	-875
$\frac{15}{84}$	-23438	$\frac{11}{16}$	-5625	$\frac{57}{48}$	-89063
$\frac{1}{4}$	-25	$\frac{21}{16}$	-57813	$\frac{35}{48}$	-90625
$\frac{17}{84}$	-26563	$\frac{13}{16}$	-59375	$\frac{59}{48}$	-92188
$\frac{9}{16}$	-28125	$\frac{23}{16}$	-60938	$\frac{11}{9}$	-9375
$\frac{19}{84}$	-29688	$\frac{5}{8}$	-625	$\frac{61}{48}$	-95313
$\frac{5}{8}$	-3125	$\frac{21}{16}$	-64063	$\frac{31}{48}$	-96875
$\frac{21}{84}$	-32813	$\frac{23}{16}$	-65625	$\frac{53}{48}$	-98438

DECIMALS OF A FOOT FOR

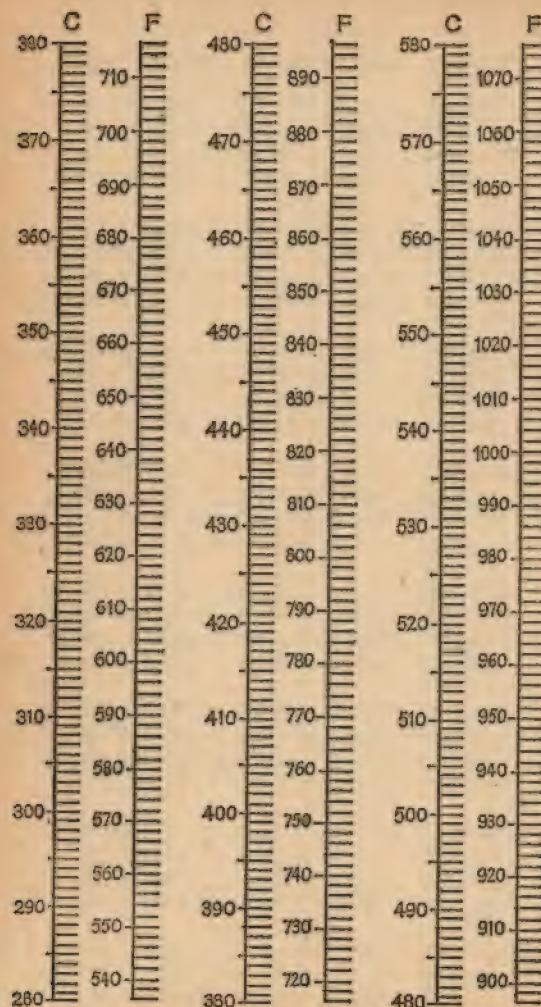
Inch	0	1	2	3	4	5
0	0.0	0.0833	0.1667	0.2500	0.3333	0.4167
$\frac{1}{3}$	.0026	.0859	.1693	.2526	.3359	.4193
$\frac{1}{6}$	.0052	.0885	.1719	.2552	.3385	.4219
$\frac{3}{8}$	.0078	.0911	.1745	.2578	.3411	.4245
$\frac{1}{4}$	.0104	.0938	.1771	.2604	.3438	.4271
$\frac{5}{12}$	.0130	.0964	.1797	.2630	.3464	.4297
$\frac{1}{6}$	.0156	.0990	.1823	.2656	.3490	.4323
$\frac{7}{12}$	.0182	.1016	.1849	.2682	.3516	.4349
$\frac{1}{3}$	.0208	.1042	.1875	.2708	.3542	.4375
$\frac{9}{16}$	.0234	.1068	.1901	.2734	.3568	.4401
$\frac{5}{8}$	.0260	.1094	.1927	.2760	.3594	.4427
$\frac{11}{16}$	.0286	.1120	.1953	.2786	.3620	.4453
$\frac{3}{4}$	.0313	.1146	.1979	.2813	.3646	.4479
$\frac{13}{16}$	.0339	.1172	.2005	.2839	.3672	.4505
$\frac{7}{8}$	.0365	.1198	.2031	.2865	.3698	.4531
$\frac{15}{16}$	.0391	.1224	.2057	.2891	.3724	.4557
$\frac{1}{2}$	.0417	.1250	.2083	.2917	.3750	.4583
$\frac{17}{16}$	.0443	.1276	.2109	.2943	.3776	.4609
$\frac{9}{10}$	.0469	.1302	.2135	.2969	.3802	.4635
$\frac{19}{16}$	.0495	.1328	.2161	.2995	.3828	.4661
$\frac{5}{8}$	.0521	.1354	.2188	.3021	.3854	.4688
$\frac{21}{16}$	.0547	.1380	.2214	.3047	.3880	.4714
$\frac{11}{10}$	.0573	.1406	.2240	.3073	.3906	.4740
$\frac{23}{16}$	.0599	.1432	.2266	.3099	.3932	.4766
$\frac{3}{4}$	.0625	.1458	.2292	.3125	.3958	.4792
$\frac{25}{16}$	.0651	.1484	.2318	.3151	.3984	.4818
$\frac{13}{10}$	.0677	.1510	.2344	.3177	.4010	.4844
$\frac{27}{16}$	.0703	.1536	.2370	.3203	.4036	.4870
$\frac{7}{8}$	.0729	.1563	.2396	.3229	.4063	.4896
$\frac{29}{16}$	.0755	.1589	.2422	.3255	.4089	.4922
$\frac{15}{10}$	.0781	.1615	.2448	.3281	.4115	.4948
$\frac{31}{16}$	.0807	.1641	.2474	.3307	.4141	.4974
1	—	—	—	—	—	—

 EACH $\frac{1}{12}$ ND OF AN INCH

Inch	6	7	8	9	10	11
0	0.5000	0.5833	0.6667	0.7500	0.8333	0.9167
$\frac{1}{2}$	.5026	.5859	.6693	.7526	.8359	.9193
$\frac{1}{6}$	.5052	.5885	.6719	.7552	.8385	.9219
$\frac{3}{8}$	.5078	.5911	.6745	.7578	.8411	.9245
$\frac{1}{4}$	.5104	.5938	.6771	.7604	.8438	.9271
$\frac{5}{12}$	.5130	.5964	.6797	.7630	.8464	.9297
$\frac{1}{5}$	.5156	.5990	.6823	.7656	.8490	.9323
$\frac{7}{12}$	.5182	.6016	.6849	.7682	.8516	.9349
$\frac{1}{3}$	.5208	.6042	.6875	.7708	.8542	.9375
$\frac{9}{16}$	.5234	.6068	.6901	.7734	.8568	.9401
$\frac{6}{10}$	.5260	.6094	.6927	.7760	.8594	.9427
$\frac{11}{16}$	.5286	.6120	.6953	.7786	.8620	.9453
$\frac{3}{5}$	.5313	.6146	.6979	.7813	.8646	.9479
$\frac{13}{16}$	.5339	.6172	.7005	.7839	.8672	.9505
$\frac{7}{8}$	.5365	.6198	.7031	.7865	.8698	.9531
$\frac{15}{16}$	.5391	.6224	.7057	.7891	.8724	.9557
$\frac{1}{2}$	.5417	.6250	.7083	.7917	.8750	.9583
$\frac{17}{16}$	.5443	.6276	.7109	.7943	.8776	.9609
$\frac{9}{10}$	.5469	.6302	.7135	.7969	.8802	.9635
$\frac{19}{16}$	.5495	.6328	.7161	.7995	.8828	.9661
$\frac{5}{8}$	.5521	.6354	.7188	.8021	.8854	.9688
$\frac{21}{16}$	.5547	.6380	.7214	.8047	.8880	.9714
$\frac{11}{10}$	.5573	.6406	.7240	.8073	.8906	.9740
$\frac{23}{16}$	.5599	.6432	.7266	.8099	.8932	.9766
$\frac{3}{4}$	.5625	.6458	.7292	.8125	.8958	.9792
$\frac{25}{16}$	.5651	.6484	.7318	.8151	.8984	.9818
$\frac{13}{10}$	.5677	.6510	.7344	.8177	.9010	.9844
$\frac{27}{16}$	.5703	.6536	.7370	.8203	.9036	.9870
$\frac{7}{8}$	.5729	.6563	.7396	.8229	.9063	.9896
$\frac{29}{16}$	.5755	.6589	.7422	.8255	.9089	.9922
$\frac{15}{10}$	.5781	.6615	.7448	.8281	.9115	.9948
$\frac{31}{16}$	.5807	.6641	.7474	.8307	.9141	.9974
1	—	—	—	—	—	1.0000

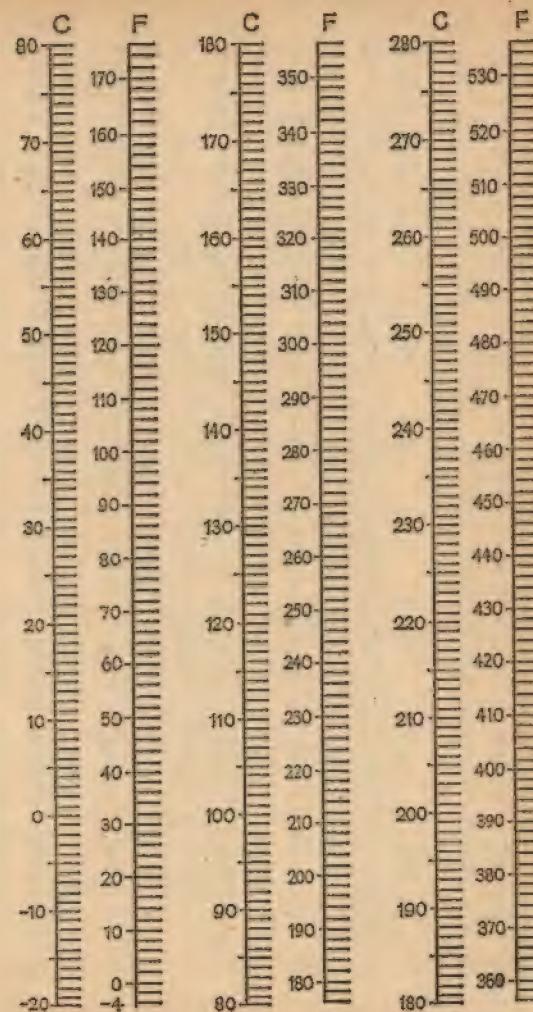
TEMPERATURE CONVERSION CHART

C = Centigrade F = Fahrenheit



TEMPERATURE CONVERSION CHART

C = Centigrade F = Fahrenheit



PRESSURE CONVERSION TABLE

Kg. per sq. cm.	Pounds per Square Inch									
	0	0-1	0-2	0-3	0-4	0-5	0-6	0-7	0-8	0-9
0	0.00	142	285	427	569	712	853	996	1138	1280
1	14-22	15-65	17-07	18-49	19-91	21-34	22-76	24-18	25-60	27-02
2	28-45	29-87	31-29	32-71	34-14	35-56	36-98	38-40	39-83	41-25
3	42-67	44-09	45-52	46-94	48-36	49-78	51-20	52-63	54-05	55-47
4	56-89	58-32	59-74	61-16	62-58	64-01	65-43	66-85	68-27	69-69
5	71-12	72-54	73-96	75-38	76-81	78-29	79-65	81-07	82-30	83-92
6	85-34	86-76	88-19	89-61	91-03	92-45	93-87	95-30	96-72	98-14
7	99-56	100-99	102-41	103-83	105-25	106-67	108-10	109-52	110-94	112-36
8	113-79	115-21	116-63	118-05	119-48	120-90	122-32	123-74	125-17	126-59
9	128-01	129-43	130-85	132-28	133-70	135-12	136-54	137-97	139-39	140-81
10	142-23	143-66	145-08	146-50	147-92	149-34	150-77	152-19	153-61	155-03

VISCOSITY CONVERSION TABLE

Seconds Redwood No. 1	Seconds Saybolt Universal	Degrees Engler	Kinematic Viscosity Stokes
30	33	1-06	0-015
40	45	1-45	0-058
60	68	2-08	0-126
80	91	2-73	0-185
100	114	3-37	0-237
150	170	4-91	0-365
200	226	6-51	0-487
220	248	7-15	0-532
250	283	8-15	0-617
300	340	9-78	0-741
350	397	11-4	0-865
400	452	13-0	0-988
450	508	14-7	1-11
500	564	16-3	1-23
600	676	19-5	1-48
700	790	22-8	1-73
800	902	26-1	1-97
900	1015	29-3	2-22
950	1068	30-9	2-34
1000	1130	32-6	2-47
1100	1242	35-9	2-71
1200	1354	39-1	2-96
1300	1467	42-4	3-21
1400	1576	45-7	3-46
1500	1690	48-9	3-70
1600	1804	51-2	3-95
1700	1914	55-4	4-20
1800	2028	58-7	4-45
1900	2144	62-0	4-70
2000	2255	65-2	4-94
2200	2478	71-8	5-43
2400	2696	78-2	5-93
2600	2924	84-8	6-42
2800	3142	91-3	6-92
3000	3370	97-8	7-41
3250	3650	105-9	8-03
3500	3935	114-1	8-65
3750	4220	122-2	9-26
4000	4500	130-2	9-88
4500	5060	146-6	11-11
5000	5620	163-0	12-34

SPEEDS OF FLOW OF WATER

Pipe Bore Inches	Velocity in Feet per Second				
	2	4	6	8	10
Gallons per Hour					
$\frac{1}{4}$	15	30	46	61	76
$\frac{1}{2}$	34	69	103	137	172
$\frac{1}{4}$	61	122	184	245	306
$\frac{3}{4}$	94	190	285	380	474
$\frac{5}{8}$	138	276	414	552	690
1	245	490	735	980	1225
$1\frac{1}{4}$	382	765	1150	1530	1910
$1\frac{1}{2}$	550	1100	1650	2200	2750
2	980	1960	2940	3920	4900
$2\frac{1}{2}$	1530	3060	4590	6120	7650
3	2200	4410	6620	8820	11000
4	3920	7840	11750	15700	19600
5	6120	12250	18350	24500	30600
6	8800	17600	26400	35200	44000
7	12000	24000	36000	48000	60000

MATERIAL DENSITIES

Material	Pounds per cubic foot	Cubic feet per ton	Cubic inches per pound
Fresh water	62	36	28
Sea water	64	35	27
Resin	66	34	26
Ground dry fireclay	70	32	24.6
Saltcake			
Bones			
Nitrate of ammonia	72	31	24
Nitrate of soda			
Chalk lumps			
Loose earth	78	29	22
Calcined limestone			
Crushed chalk			
Earth			
Loose clay and marl	80	28	21.6
Crushed slag			
Ground gypsum			
Phosphate rock	81	27.5	21
Blast furnace slag			
Crushed silica			
Portland cement			
Shingle	88	25.5	19.5
Broken limestone			
Coprolites	90	25	19.3
Clay shale, loose			
Dried mud	93	24	18.5
Stone dust			
Granite chippings	95	23.6	18.2
Fine sand			
Coarse gravel	96	23.2	17.9
Plaster			
Cement clinker			
Coarse pit sand			
Common bricks			
Crushed basalt	100	22.4	17.2
Pit dirt			
Phosphate pebble			
Slate dust			
Hard bath stone, broken	102	22	17
Plaster of Paris			
Lead ore	106	21	16.2
Gravel, average			
Bauxite	109	20.5	16
Phosphate meal			
	110	20.4	15.7

MATERIAL DENSITIES (continued)

Material	Pounds per cubic foot	Cubic feet per ton	Cubic inches per pound
Ballast, loose			
Powdered sulphur	112	20	15.4
Tin ore			
Asphalt, loose			
Ground cement	120	18.7	14.5
Concrete			
Gypsum, broken			
Bath stone			
Solid chalk	125	18	14
Solid rock sulphur			
Barytes			
Red sandstone	130	17	13
Powdered phosphate			
Derby stone, broken			
Salt rock	136	16.5	12.7
Plumbago			
Portland stone, broken	140	16	12.5
Sandstone, broken			
Quartz, broken			
Granite, broken			
Spanish iron ore	150	15	11.5
Iron pyrites	156	14.3	10.6
Shale			
Zinc spelter	162	13.8	10.5
Crushed dolomite	165	13.5	10.4
Quartz sand	170	13	10.2
Lead oxide	184	12.2	9.4
Copper pyrites, fine	187	12	9.6
Iron ore, Clydesdale	190	11.8	9.5
Tin ore	200	11.2	8.2
Brown iron ore	245	9.2	7.1
Red iron ore	320	7	5.4
Dry hops	6.5	350	270
Cork dust	7	320	246
Dry sawdust	8	280	216
Wood meal	8.5	270	208
Bran			
Dry Peat	11	204	157
Beet, dried pulp	14	160	125
Flaked soap	16	140	108
Ground oak bark	17	132	102
Logwood dust			
Flue dust	18	124	95

MATERIAL DENSITIES (continued)

Material	Pounds per cubic foot	Cubic feet per ton	Cubic inches per pound
Dry paper pulp	20	112	86
Green malt	22	100	77
Cotton seed			
Breadcrumbs			
Charcoal			
Locust beans	23	97	75
Calcined bones			
Degreased crushed bones	25	90	69
Seedlac			
Spent tan	27	83	64
Shredded soap			
Wood chips	28	80	61.5
Damp wood pulp			
Dry apple pulp or pumice			
Gas coke	30	75	58
Malt			
Oats			
Hempseed	31	72	55
Crushed bones			
Hydrated lime	35	64	49
Soda ash			
Cotton seed			
Rape seed	36	62	47
Spent hops			
Buckwheat	37	61	46
Sugar beet	38	59	45
Coke breeze			
Barley			
Hot wet grains	39	58	44.5
Oatmeal			
Furnace coke			
Gasworks lime	40	56	43
Steamed bones			
Indian corn meal			
Linseed	41	55	42
Rye			
Bean and pea meal			
Flour	43	52	40
Coal nuts			
Coal ashes	44	51	39

MATERIAL DENSITIES (continued)

Material	Pounds per cubic foot	Cubic feet per ton	Cubic inches per pound
Anthracene			
Powdered coal			
Indian corn or maize			
Coarse salt	45	50	38.5
Soda ash			
Sodium bicarbonate	46	49	37.7
Potatoes			
Wheat	47	48	37
Horse beans	49	46	35.5
Peas and beans			
Fine white sugar			
Broken ice	50	45	34.6
Sulphate of ammonia			
Wet char			
Welsh steam coal			
Anthracite coal, loose			
Quicklime	53	42	32.5
Rye			
Bone meal			
Block ice			
Boiler ashes	56	40	31
Asbestos grit			
Broken glass or cullet			
Crushed dolomite (calcined)			
Pitch			
Oxide of iron			
Wet bone char			
Superphosphate of lime	60	37	28.5

RELATIVE HUMIDITY TABLES

Relative Humidity

Relative humidity is defined as the ratio, expressed as a percentage, between the water vapour in air at a given temperature and the maximum water vapour the air can hold (i.e. saturated air) at the same temperature.

How to use the tables:

Take the reading of the wet-bulb and dry-bulb temperatures at as nearly the same moment as possible.

Subtract the wet-bulb reading from the dry-bulb reading.

The per cent relative humidity is the number at the intersection of the temperature difference column (vertical) with the dry-bulb temperature column (horizontal).

Per cent Relative Humidity for Centigrade Temperature Differences Up to 45°

Dry-Bulb Temp., °C.	Difference Between Wet- and Dry-Bulb Readings, Degrees Centigrade: 760 mm Hg														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	82	82	82	82	82	82	82	82	82	82	82	82	82	82	82
2	64	64	64	64	64	64	64	64	64	64	64	64	64	64	64
3	57	57	57	57	57	57	57	57	57	57	57	57	57	57	57
4	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
5	43	43	43	43	43	43	43	43	43	43	43	43	43	43	43
6	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36
7	29	29	29	29	29	29	29	29	29	29	29	29	29	29	29
8	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23
9	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17
10	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
11	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
12	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
35	70	64	59	54	49	44	40	36	32	28	24	20	17	13	10
36	70	65	60	55	51	47	43	38	34	30	26	22	19	15	11
37	70	65	60	55	51	47	43	38	34	30	26	22	19	15	11
38	70	66	61	56	51	47	43	38	34	30	26	22	19	15	11
39	70	66	61	56	51	47	43	38	34	30	26	22	19	15	11
40	70	67	62	57	53	49	44	40	35	32	28	24	20	17	14
41	70	68	63	58	54	50	46	42	37	33	29	25	21	18	14
42	70	68	63	58	54	50	46	42	37	33	29	25	21	18	14
43	70	68	63	58	54	50	46	42	37	33	29	25	21	18	14
44	70	68	63	58	54	50	46	42	37	33	29	25	21	18	14
45	70	68	63	58	54	50	46	42	37	33	29	25	21	18	14
46	70	68	63	58	54	50	46	42	37	33	29	25	21	18	14
47	70	68	63	58	54	50	46	42	37	33	29	25	21	18	14
48	70	68	63	58	54	50	46	42	37	33	29	25	21	18	14
49	70	68	63	58	54	50	46	42	37	33	29	25	21	18	14
50	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
51	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
52	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
53	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
54	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
55	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
56	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
57	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
58	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
59	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
60	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
61	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
62	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
63	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
64	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
65	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
66	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
67	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
68	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
69	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
70	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
71	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
72	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
73	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
74	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
75	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
76	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
77	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
78	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
79	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
80	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
81	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
82	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
83	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
84	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
85	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
86	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
87	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
88	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
89	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
90	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
91	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
92	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
93	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
94	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
95	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
96	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
97	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
98	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
99	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14
100	70	69	64	59	54	49	44	40	36	32	28	24	20	17	14

Dry-Bulb Temp., °C.	Difference Between Wet- and Dry-Bulb Readings, Degrees Centigrade: 760 mm Hg													
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

<tbl_r cells="14" ix="2" maxcspan="1" maxrspan="1" usedcols="

Per cent Relative Humidity for Fahrenheit Temperature Differences Up to 45°

Difference between Wet- and Dry-Bulb Readings, Degrees Fahrenheit: Pressure 30°																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15															
96	96.93	89.86	82	79.76	73	69.66	63	61	58	55	52	50	47	44	42															
97	96.93	89.86	82	79.76	73	69.66	63	61	58	55	52	50	48	45	43															
98	96.93	89.86	83	79.76	73	69.67	64	61	58	56	53	50	48	45	43															
99	96.93	89.86	83	79.76	73	69.67	64	61	58	56	53	50	48	45	43															
100	96.93	89.86	83	80	77.77	72	69	66	63	60	58	55	52	50	48															
105	97.93	90.87	83	80	77.77	72	69	66	63	60	58	55	52	50	48															
110	97.93	90.87	84	81	78	75	73	70	67	65	62	60	57	54	52															
115	97.94	91.88	85	82	79	76	74	72	68	66	63	62	60	57	54															
120	97.94	91.88	85	82	80	77	74	72	69	67	65	63	62	60	58															
125	97.94	91.88	85	82	80	77	74	72	69	67	65	63	62	60	58															
130	97.94	91.89	86	83	81	78	75	73	71	69	67	64	62	60	58															
135	97.94	91.89	86	83	81	78	75	73	71	69	67	64	62	60	58															
140	97.94	91.89	87	84	82	79	76	74	72	69	67	64	62	60	58															
145	98.95	93.90	87	84	82	80	78	76	73	71	69	67	65	63	61															
150	98.95	93.90	87	85	83	80	78	76	73	71	69	67	65	63	61															
155	98.95	93.90	87	85	83	80	78	76	74	72	70	68	66	64	62															
160	98.95	93.90	88	85	83	81	78	76	74	72	70	68	66	64	62															
165	98.95	93.91	88	86	84	82	79	76	74	72	70	68	66	64	62															
170	98.96	94.91	89	86	84	82	79	76	74	72	70	68	66	64	62															
175	98.96	94.91	89	86	84	82	80	78	76	74	72	70	68	66	64															
180	98.96	94.92	89	87	85	83	81	79	77	75	73	72	70	68	66															
185	98.96	94.92	89	87	85	83	81	79	77	75	73	72	70	68	66															
190	98.96	94.92	90	87	85	83	82	80	78	76	74	73	71	69	66															
195	98.96	94.92	90	88	86	84	82	80	78	76	74	73	71	69	67															
200	98.96	94.92	90	88	86	84	82	80	78	76	74	72	70	69	67															
205	98.96	94.92	90	88	86	84	83	81	79	77	74	72	70	69	67															
210	98.96	94.93	90	88	87	85	83	81	80	78	76	75	73	71	69															
	Dry-Bulb Reading °F.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15														
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45

ATOMIC WEIGHTS—PHYSICAL AND CHEMICAL SCALES

Recently the Council of the International Union of Pure and Applied Chemistry resolved that a scale of atomic weights based on the whole number 12, as the atomic weight of the dominant natural isotope of carbon, carbon 12, be adopted.

In the tables which follow atomic weights are given based on carbon, as it occurs naturally, = 12. The difference between the atomic weights quoted and those related to C¹² = 12 amounts to less than 43 parts per million. Natural carbon consists of two isotopes, C¹² and C¹³, of relative abundance 98.892% and 1.108%. The chemical basis for the atomic weights is thus an average value for the mixture. This is a valid basis for the table since the relative abundance of the two isotopes is practically constant.

In physics it is the behaviour of individual atoms which is of importance, so an average value for their relative weight is not suitable. Consequently, for physical measurements, a new table of atomic weights has been produced based on the one isotope C¹² = 12.000. To avoid confusion in terminology it is the modern practice to give the units of weight on this scale the name atomic mass unit (a.m.u.), e.g. C¹² = 12.000 a.m.u.; 1 a.m.u. = 1.6598 × 10⁻²⁴ g. Mass spectrographs can determine the relative weights of individual isotopes with high accuracy. Knowing the relative abundance of the carbon isotopes, the average 'atomic weight' of naturally occurring carbon can be found.

THE PERIODIC
giving atomic number, chemical symbol

Group 1		Group 2		Group 3		Group 4		Group 5	
A	B	A	B	A	B	A	B	A	B
1 H 1-0080	—	—	—	—	—	—	—	—	—
3 Li 6-940	—	4 Be 9-013	—	5 B 10-81	—	6 C 12-00	—	7 N 14-007	—
11 Na 22-990	—	12 Mg 24-31	—	13 Al 26-98	—	14 Si 28-09	—	15 P 30-974	—
19 K 39-102	—	20 Ca 40-08	—	21 Sc 44-956	—	22 Ti 47-90	—	23 V 50-94	—
—	29 Cu 63-54	—	30 Zn 65-37	31 Ga 69-72	—	32 Ge 72-59	—	33 As 74-92	—
37 Rb 85-47	—	38 Sr 87-62	—	39 Y 88-90	—	40 Zr 91-22	—	41 Nb (Nb) 92-91	—
—	47 Ag 107-870	—	48 Cd 112-40	49 In 114-82	—	50 Sn 118-69	—	51 Sb 121-75	—
55 Cs 132-90	—	56 Ba 137-34	—	—	57-71 Rare Earths (see opposite box)	—	72 Hf 178-49	—	73 Ta 180-95
—	79 Au 197-0	—	80 Hg 200-59	81 Tl 204-37	—	82 Pb 207-19	—	83 Bi 208-98	—
87 Fr [223]	—	88 Ra 226-05	—	—	89-100 Actinium Series (see page 130)	—	—	—	—

— Mass number of

TABLE
and atomic weight (C = 12-00)

Group 6		Group 7		Group 8			Group 0	Electron Orbital No.
A	B	A	B	—	—	—	—	—
—	—	—	—	—	—	—	—	2 He 4-003
8 O 15-999	—	9 F 19-000	—	—	—	—	—	8 Ne 20-183
16 S 32-064	—	17 Cl 35-453	—	—	—	—	—	8 S 39-948
—	24 Cr 52-00	—	25 Mn 54-94	26 Fe 55-85	27 Co 58-93	28 Ni 58-71	—	8 18 8
34 Se 78-96	—	35 Br 79-909	—	—	—	—	—	8 Kr 83-80
—	42 Mo 95-94	—	43 Tc [99]	44 Ru 101-1	45 Rh 102-90	46 Pd 106-4	—	8 18 18 8
52 Te 127-60	—	53 I 126-90	—	—	—	—	—	8 Xe 131-30
—	74 W 183-85	—	75 Re 186-20	76 Os 190-2	77 Ir 192-2	78 Pt 195-09	—	8 18 32 18 8
84 Po [210]	—	85 At [210]	—	—	—	—	—	8 Rn [222]
—	—	—	—	—	—	—	—	—

longest lived isotope

THE PERIODIC TABLE (*continued*)

The Rare Earths				Electron Orbital No.
57 La 138-91	58 Ce 140-12	59 Pr 140-91	60 Nd 144-24	
61 Pm [147]	62 Sm 150-35	63 Eu 152-0	64 Gd 157-25	18
65 Tb 158-92	66 Dy 162-50	67 Ho 164-93	68 Er 167-26	32
69 Tm 168-93	70 Yb 173-04	71 Lu 174-97	—	9
			—	2

The Actinium Series				Electron Orbital No.
89 Ac 227	90 Th 232-04	91 Pa [231]	92 U 238-03	
93 Np [237]	94 Pu [242]	95 Am [243]	96 Cm [247]	18
97 Bk [247]	98 Cf [249]	99 Es [254]	100 Fm [253]	32
101 Mv [256]	102 No [253]	103 Lw [257]	—	2

PROPERTIES OF SOLIDS

Substance	Density (g./cm. ³)	Specific heat	Melting point (°C.)	Latent heat of fusion	Coeff. of lin. expansion ($\times 10^{-5}$)	Thermal conductivity 18° C. 18° C.	Specific resistance (microhenn. at 18° C.)	Temp. coeff. of resistance
Aluminium	2.70	0.416	660.1	38.3	.23	.480	.492	-.0043
Antimony	6.68	.049	630.5	.10	.044	.040	.40-0	~.003
Bismuth	9.80	.030	271.5	.133	.0194	.0161	106.8 (0° C.)	~.0045
Brass	8.2-8.8	.089	950-1050	—	~.26	~.0015	6.9	-.001-0.02
Brick	1.5-2.0	.08	—	.03-.09	.012	1375 (0° C.)	—	-.00556 to -.0088
Carbon (Graphite)	2.3	.07	3700	.58-4	.123	.165	5.6	-.0033
Cobalt	8.9	.10	1492	.10	.1-1.5	.0003	47	~.0002 to +.0005
Concrete	2.2	.08	—	.1320	.17	.054	.064	~.039
Copper	8.96	.492	1063	.50-6	.167	.918	.908	—
Cork	.22-.26	.49	—	—	—	.00012	1.7	—
German Silver	8.5-8.9	.093	c. 1050	—	.184	.070	.089	~.004
Glass (Crown)	2.5-2.7	.16	1100	—	.090	.0025	33	—
Glass (Flint)	2.9-4.5	.12	1063-0	—	.079	.002	~10 ¹⁶	—
Gold	19.3	.0316	1063-0	16.1	.142	.707	.703	.0034
Ice	.91-.92	.502	0	79.71	.51	.005	3 x 10 ¹⁴	—
India-rubber	.21-.48	.12	1500	—	.704	.00045	8 x 10 ¹⁰	~.02
Invar	8.0	.12	c. 1100	{ Grey White 23 33 }	~.009	—	81	—
Iron (Cast)	7.0-7.7	.19	1535	6.3	~.106	~.18	10	—
Iron (Wrought)	7.8-7.9	.115	1527-3	—	.117	.144	.143	.006
Lead	11.34	.03	327.3	.6-3	.287	.083	.032	.0043
Magnesium	.65	.22	610	—	.24	—	—	~.00091
Marble	2.5-2.8	.036	—	—	.18	.052	.063	44.5
Naphthalene	1.15	.313	80	35.6	~.1	.007	—	~10 ¹⁵
Nickel	8.9	.11	1453	73.8	1.07	.00095	—	—
Paraffin wax	.97-.93	.69	c. 54	35.1	~.13	.142	.138	.006
Perspex (Plasticised)	1.19	.35	78 (softens)	—	.10	.0006	3 x 10 ¹¹	—
Phosphor Bronze	8.8-8.9	—	1030-1070	.975	.0005	—	> 10 ¹⁴	~.003-0.04
Platinoid	2.2	.0224	1769	27.1	—	.060	.173	~.00025
Platinum	2.46	.186	c. 1750	135-260	~.089	.166	.173	~.0038
Plumbum	10.5	.056	960-8	24.3	.19	.022	10 ¹⁵ -10 ¹⁴	10 ¹⁵
Quartz	2.07	.295	97.7	27.5	.71	.32	.9919	.004
Silicon	2.3	.054	112.8	9.3	.64	.0063	~10 ¹⁴	~.005
Silver	7.3	.054	231.9	14.4	.23	.155	.145	~.0039
Sulphur	1.97	.265	7.14	—	.31	.265	.262	~.004

PROPERTIES OF LIQUIDS

Substance	Density at 0° C. (g./cm. ³)	Surface tension at 20° C. (dynes per centimetre)	Viscosity at 20° C. (dynes per sec. per centimetre)	Specific heat at 20° C. (cal./g. per degree)	Latent heat of vaporization at B.P. (°C.)	Boiling point (°C.)	Freezing point (°C.)	Coefficient of expansion at 15° C. (1/meter)	Electrical resistivity at 18° C. (ohm-cm.)	Index of refraction at 15° C. (D ₂₀)	For D ₂₀ at 15° C.
Alcohol (Ethyl) (C ₂ H ₅ O)	.792	22.3	.0119	.0065	.00993	.00110	-.1144	.000423	3×10^4	1.362	
Benzene or Benzol. (C ₆ H ₆)	.879 at 20°	28.9	.41	.80.2	.95	.54	-.00124	.000333	—	1.501	
Bromine (Br ₂)	3.1 at 25°*	44	.11	.58.8	.43.7	-.732	-.00113	—	—	1.66	
Carbon Bisulphide (CS ₂)	1.292	33	.00163	.00558	.23	.65.2	-.110	.00122	.000543	1.610	
Chloroform (CHCl ₃)	1.527	27.1	.00234	.00234	.54	.61.5	-.63	.00126	.000288	1.446	
Ether (C ₂ H ₅ O)	1.736	17	.00234	.00234	.34	.34.6	-.83.9	-.00126	.000303	1.350	
Glycerine (C ₃ H ₈ O ₃)	1.736	63-14	.13.4	.29.0	.58	.29.0	—	-.00166	.000637	1.473	
Hydrochloric Acid (HCl)	{20 per cent sol.)	1.10	.74	—	.70	.110	—	-.65	—	1.3	1.41
Mercury (Hg)	13.595	487	—	.0156	.033	.356-58	.70	-.38.87	.000182	.019	.000058
Nitric Acid (HNO ₃)	{20 per cent sol.)	1.12	—	—	.82	.104	—	-.24	—	1.4	1.40
Nitro-benzene (C ₆ H ₅ NO ₂)	1.21	32	.84	.0203	.34	.211	.79.2	5.7	.00086	—	1.553
Olive Oil	.92	—	.47	.c. 300	—	—	—	—	.00070	.000405	1.48
Sulphuric Acid (H ₂ SO ₄)	1.14	.76	—	.84	.105	—	—	-.38	.00051	.00130	1.53
Turpentine (C ₁₀ H ₁₆)	.87	27.3	—	.0149	.42	.156	.70	-.10	.00097	.00325	1.48
Water (H ₂ O)	.99967	72.75	—	.01002	1.0	.100	.539-55	0	—	.00141	{9.1 $\times 10^3$ (at 4° C.)}
Water (Sea)	1.025	—	.94	.104 (?)	—	—	—	—	—	—	{1.333 (at 21°)}
											1.343

* The temperature coefficient of resistance of electrolytes is negative, and varies from -5 per cent to 2 per cent per degree Centigrade.

PROPERTIES OF GASES AND VAPOURS

N.B.—Where not otherwise indicated the various columns refer to gases at 0° C. and 760 mm. pressure	Density in g. per litre	Viscosity in 10 ⁻⁶ dyne per cm. ² per unit grad. (η)	Critical temp. (°C.) (θ _c)	Critical pressure in atmos. (p _c)	Critical volume (cm. ³) (v _c)	Boiling point (sub. pt.)	Freezing point (°C.)	Latent heat of vaporization (cal./g.)	Specific heat (constant pressure) (c _p)	Ratio of specific heats (c _p /c _v)	
Acetylene (C ₂ H ₂)	1.173	93.5	36.0	61.6	4.33	-.83.6	-.81.8	—	—	.38	1.26
Air	1.293	183.25/23*	—140.7	37.2	2.86	-.190	—	50.97	.237	1.402	
Ammonia (NH ₃)	.771	91.8	132.4	111.5	4.26	-.33.35	—	327.1	.523	1.310	
Argon (A)	1.784	210	—122	.48	.188	-.186	—	37.6	.125	1.667	
Carbon Dioxide (CO ₂)	1.977	140	31.1	.73	2.17	-.78.5	—	199	.199	1.304	
Carbon Monoxide (CO)	1.250	166	—139	.35.0	3.22	-.192	—	50.4	.250	1.404	
Chlorine (Cl ₂)	3.214	129	144	.76.1	1.75	—10.7	—	67	.114	1.36	
Cyanogen (C ₂ N ₂)	2.337	92.8	128	.59.0	4.55	—10.3	—	—	.41	1.26	
Ethylene (C ₂ H ₄) (Olefiant Gas)	1.260	90.7	.97	.267.9	2.26	14.45	—	—	.399	1.18	
Helium (He)	1.736	186	—239.9	12.8	23.25	—252.8	—	1.25	—	1.66	
Hydrogen Chloride (HCl)	.0892	83.5	.51.4	.81.6	2.38	—84	—	123	3.42	1.41	
Hydrogen Sulphide (H ₂ S)	1.640	138	100.4	.88.9	.00578	—61.8	—	19	.19	1.40	
Methane (CH ₄) (Marsh-Gas)	1.538	117	103	.82.5	45.8	6.17	—16.49	—	1.307	1.313	
—Fire-Damp—	.717	103	—94.0	.65	1.92	—15.2	—160.9	—	—	—	
Nitric Oxide (NO)	1.340	178	36.5	71.7	2.22	—89.8	—102	67(-20°)	.213	1.303	
Nitrous Oxide (N ₂ O) (Laughing Gas)	1.978	135	—147.1	33.5	—	—	—	—	—	—	
Nitrogen (N ₂) †	1.250	167	—118.9	49.7	2.33	—195.8	—209.9	50	.248	1.404	
Oxygen (O ₂)	1.429	189	—118.8	177.7	1.92	—132.9	—218.4	58	.218	1.40	
Sulphur Dioxide (SO ₂)	2.927	117	157.2	217.7	2.5	—16.73	—100	59.55	.154	1.26	
Steam at 100° C.	.581	126	374	—	—	—	—	59.55	.482	1.324	
Water Vapour (0°)	.80	87	—	—	—	—	—	—	—	—	

* θ_c = vol. at θ_c and ρ_c of unit mass of gas = reciprocal of critical density. It can be solidified by the application of 1.25 atmospheres pressure at about 1° Absolute.

† One litre of atmospheric nitrogen contains of 988.14 c.c. of pure nitrogen and 11.86 c.c. of argon, and has a weight of 1.257 g./cm.³. The volume of any gas at N.T.P. is 22.415 litres, and this volume of any gas is called a gram-molecular volume, or gram-mole.

‡ The coefficient of expansion at constant pressure for all ordinary gases may be taken as $\alpha = \frac{1}{T}$, or -0.00362. For the perfect gas it is taken as $\alpha = \frac{1}{T}$.

PROPERTIES OF THE ELEMENTS

Element	Atomic No.	Symbol	Atomic weight (C = 12)	Valency *	Electro-chemical equivalent (g. per Kilocalorie) †	Density (g./cm. ³) at 20°C.	Melting-point (°C.) (temp. above pt. may be uncertain by over 50°)	Boiling-point (°C.) at 760 mm.
Actinium	89	Ac	227.0	{ 2	1.766 -7843	—	1600	—
Aluminum	13	Al	26.98	{ 3	4.932 —	2.70 —	660-1	~2500
Americanium	95	Am	243	{ 5	4.207 —	6.7	630-5	—
Antimony	51	Sb	121.75	{ 5	2.524 —	—	1440	1440
Argon	18	A	39.9418	{ 0	—	—	—189.3	{ sublim. at 616
Argon	33	As	74.92	{ 3	2.588 -1.553	5.73	815	—
Asatine	85	At	210	{ 2	—	—	—	—
Barium	56	Ba	137.34	{ 2	7118	3.5	704	1600
Boronium	97	Bk	247	{ 2	0.467	—	—	—
Beryllium	4	Be	9.013	{ 2	—	1.8	1280	~3000
Bismuth	83	Bi	208.98	{ 5	7221 -4332	9.8	271-3	1477
Boron	5	B	10.81	{ 3	—	—	2300	2550
Bromine	35	Br	79.909	{ 1	—	2.34	—	—
Cadmium	48	Cd	112.40	{ 2	—	3.1/25°	—	—
Calcium	20	Ca	40.08	{ 2	—	8.65	320-9	38.8
Californium	98	Cf	249	{ 2	—	—	768	768
Carbon	6	C	12.00	4	—	1.87	28.4	1440
Curium	58	Ce	140.12	{ 3	—	1.54	851	—
Chlorine	17	Cl	35.453	{ 4	—	—	—	—
Chromium	24	Cr	52.00	{ 6	—	—	—	—
Cobalt	27	Co	58.93	{ 2	—	—	—	—

{ Nb Cb}	92.91	5	1926	8.57	—	—	3300	—
	Cu	63.54	{ 2	6585 -3293	8.96	—	2500	—
Clarium	96	Cm	247	{ 3	—	—	—	—
Dysprosium	66	Dy	162.50	{ 3	—	—	—	—
Einsteinium	99	Es	254	{ 3	—	—	—	—
Erbium	68	Er	167.26	{ 3	—	—	—	—
Europium	63	Eu	152.0	{ 3	—	—	—	—
Fermium	100	Fm	253	{ 1	—	—	—	—
Fluorine	9	F	19.00	{ 1	—	—	—	—
Francium	87	Fr	223	{ 3	—	—	—	—
Gadolinium	64	Gd	157.25	{ 3	—	—	—	—
Gallium	31	Ga	69.72	{ 3	—	—	2100	—
Germanium	32	Ge	72.59	{ 4	—	—	2700	—
Gold	79	Au	197.0	{ 1	—	—	1063-0	2950
Hafnium	72	Hf	178.49	{ 4	—	—	2200	5400
Helium	2	He	4.003	0	—	—	{ 30 atm.	—268.93
Holmium	67	Ho	164.93	{ 3	—	—	—	—
Hydrogen	1	H	1.0080	{ 1	—	—	—	—
Iodine	49	In	114.82	{ 3	—	—	—	—
Indium	53	In	126.90	{ 1	—	—	—	—
Iridium	77	Ir	192.2	{ 4	—	—	—	—
Iron	26	Fe	55.85	{ 2	—	—	—	—
Krypton	36	Kr	83.80	{ 0	—	—	—	—
Lanthanum	57	La	138.91	{ 3	—	—	—	—
Lawrencium	103	Lw	257	{ 2	—	—	—	—
Lead	82	Pb	207.49	{ 4	—	—	—	—
Lithium	3	Li	6.940	{ 1	—	—	327.3	1750
Lutetium	71	Lu	174.97	{ 3	—	—	186	1400
Magnesium	12	Mg	24.31	{ 2	—	—	650	1103

N.B. The Atomic Weights, etc., of the Elements Francium, Astatine, Technetium, Promethium and the trans-uranic elements are accurately known.

* Valencies given are those of importance in electro-chemical reactions.

† Based on 1 Faraday = 9658 coulombs.

PROPERTIES OF THE ELEMENTS (continued)

Element	Atomic No.	Symbol	Atomic weight (C = 12)	Valency *	Electro-chemical equivalent (a. per kilo-coulomb) †	Density (g./cm. ³) at 20° C.	Melting-point (°C.) (temp. above pt. may be uncertain by over 5°)	Boiling-point (°C.) at 700 mm.
Manganese	25	Mn	54.94	{ 2	2846 -1898	7.44	1245	2150
Mendelevium	101	Md	256	{ 1	2.0791 1.0396 2.486 -1657 4984	13.595/0° — 10.2 6.96 -000839	— -38.87 — 2610 840 -248.6	356.33 4700 — -246.3
Mercury	80	Hg	200.59	{ 2	—	—	—	—
Molybdenum	42	Mo	95.94	{ 4	—	—	—	356.33
Neodymium	60	Nd	144.24	{ 6	—	—	—	4700
Neon	10	Ne	20.183	{ 0	—	—	—	—
Neptunium	93	Np	237	—	—	—	—	—
Nickel	28	Ni	58.71	{ 2	3041 -2027 -0484 -0290	8.9	1453	3100
Nitrogen	7	N	14.007	{ 3	—	—	—	—
Nobelium	102	Nb	193	{ 5	—	—	—	—
Osmium	76	Os	190.2	{ 6	-0829 -5329 -2765	22.48 12.0 -0711 -0642	— 2700 1552 2.2 (red) 1.8 (yellow)	— -195.84 — -182.97
Oxygen	8	O	15.999	—	—	—	—	—
Palladium	46	Pd	106.4	{ 4	—	—	—	5500
Phosphorus	15	P	30.974	{ 5	-1071 -0116 -0116 -0358	2.2 2.2 (red) 2.2 (yellow) 21.45	3980 44.4 279 1769	— — — 4500
Platinum	78	Pt	195.09	{ 2	—	—	—	—
Plutonium	94	Pu	242	—	—	—	—	—
Potassium	19	K	39-102	{ 1	-2.4 -1.3	~9.4 -0.52 -4963	254 6.6 6.6	— 63.6 940
Praseodymium	39	Pr	140.91	—	—	—	—	770
Promethium	61	Pm	147	—	—	—	—	3300
Protactinium	91	Pa	231	—	—	—	—	—
Radium	88	Ra	226.05	{ 2	3.4 2.2	~15.4 5.0	~3000 (7) ~0.0973/0°	— —
Radon	86	Rn	222	{ 0	—	—	960 (7)	1140
							~71	~61.8

Rhenium	75	Re	186.20	—	20.5	—	3167	5900
Rhodium	45	Rh	102.50	{ 3	12.44	19.60	~4500	~4500
Rubidium	37	Rb	83.47	{ 1	1.53	38.8	713	713
Ruthenium	44	Ru	101.1	{ 6	1.777	2500	>4000	>4000
Samarium	62	Sm	150.35	{ 8	-1.316	>1330	—	—
Sandium	21	Sc	44.956	{ 3	-5.196	—	—	—
Selenium	34	Se	78.96	{ 2	-1.538	1200	688	688
Silicon	14	Si	28.09	{ 4	-4.097	220	2600	2180
Silver	47	Ag	107.870	{ 1	-0.727	1420	960.8	883
Sodium	11	Na	22.990	{ 1	1.1181	97.7	883	883
Strontronium	38	Sr	87.62	{ 2	-2.383	771	1360	1360
Sulphur	16	S	32.064	{ 2	-4.541	112.8	444.60	444.60
Tantalum	73	Ta	180.95	{ 5	-1.662	2996	—	—
Techneium	43	Tc	127.60	—	-3.749	—	—	—
Tellurium	65	Tb	158.92	{ 2	-6.613	430	1390	1390
Thallium	81	Tl	204.37	{ 3	-5.500	327 (7)	3300	3300
Thorium	90	Th	232.04	{ 4	2.1183	303.5	1460	1460
Thulium	69	Tm	168.93	{ 3	-6.014	18.2	3500 (7)	3500 (7)
Tin	50	Sn	118.69	{ 2	-5.832	—	—	—
Titanium (see Wolfram)	22	Ti	47.90	{ 4	-6.151	231.9	2270	2270
Uranium	74	U	238.03	{ 4	-3.076	1660	>3000	>3000
Vanadium	92	V	50.94	{ 3	-6.168	1133	4200	4200
Wolfram (Tungsten)	23	W	183.85	{ 5	-4.112	1720	3000 (7)	3000 (7)
Xenon	54	Xe	131.30	{ 6	-1.760	5.9	6000	6000
Ytterbium	70	Yb	173.04	{ 3	-1.056	19.32	103.0	103.0
Yttrium	39	Y	88.90	{ 3	-5.978	5.5	—	—
Zinc	30	Zn	65.37	{ 2	-3.076	1.1	1490 (7)	1490 (7)
Zirconium	40	Zr	91.22	{ 4	-1.242	7.4	910	910
							1857	5000

* Valencies given are those of importance in electro-chemical reactions.

† Based on 1 Faraday = 96488 coulombs.

INTERNATIONAL TEMPERATURE SCALE 1948
as at April 1957

All fixed points relate to standard atmospheric pressure of 1013250 dyne/cm.² (760 mm. of mercury).

Primary Fixed Points

	° C.
Boiling point of oxygen	-182.970
Freezing point of water	0
Boiling point of water	100
Boiling point of sulphur	444.600
Freezing point of silver	960.8
Freezing point of gold	1063.0

Secondary Fixed Points

	° C.
Sublimation point of solid CO ₂	-78.5
Freezing point of mercury	-38.87
Triple point of water	0.0100
Transition point of sodium sulphate decahydrate	32.38
Triple point of benzoic acid	122.36
Boiling point of naphthalene	218.0
Freezing point of tin	231.9
Boiling point of benzophenone	305.9
Freezing point of cadmium	320.9
Freezing point of lead	327.3
Boiling point of mercury	356.58
Freezing point of zinc	419.5
Freezing point of antimony	630.5
Freezing point of aluminium	660.1
Freezing point of copper (in a reducing atmosphere)	1083
Freezing point of nickel	1453
Freezing point of cobalt	1492
Freezing point of palladium	1552
Freezing point of platinum	1769
Freezing point of rhodium	1960
Freezing point of iridium	2443
Freezing point of wolfram (tungsten)	3380

Some Additional Important Temperatures

Absolute zero	0° K.	-273.15 ± 0.02° C.*
λ point of helium	2.186° K.	
Boiling point of helium	4.216° K.	
Freezing point of hydrogen	14° K.	-259.2° C.
Boiling point of hydrogen	20.4° K.	-252.8° C.
Freezing point of nitrogen	63.3° K.	-209.9° C.
Boiling point of nitrogen	77.32° K.	-195.8° C.
Freezing point of oxygen	54.8° K.	-218.4° C.

* Presently accepted value. In the U.S.A. the value -273.16° C. is preferred, while the most recent work indicates a value of -273.155 ± 0.015° C.

Dull red heat	500-600° C.
White heat	1500-1800° C.
Estimated temperature of the sun's radiating layers	6000° K.
Estimated temperature of the sun's core	2 × 10 ⁹ ° K.
Estimated temperature of the radiating layers of the hottest stars	35,000° K.

To convert degrees Celsius (centigrade) to degrees absolute add 273.15.

ATOMIC AND MOLECULAR CONSTANTS

The electronic charge (e) = 4.803×10^{-10} e.s.u. = 1.602×10^{-19} e.m.u. = 1.602×10^{-19} coulombs.
Electronic mass (m_e) = 9.108×10^{-28} g.

Specific electronic charge $\left(\frac{e}{m_e}\right)$ = 5.273×10^{17} e.s.u./g. = 1.759×10^7 e.m.u./g. = 1.759×10^8 coulomb/g.
Mass of hydrogen atom (M_H) = 1.673×10^{-24} g.
Mass of proton (M_p) = 1.672×10^{-24} g.
Mass of neutron (M_n) = 1.675×10^{-24} g.

$$\frac{M_H}{m_e} = 1837 \quad \frac{M_p}{m_e} = 1836.$$

Velocity of light (c) = 2.998×10^{10} cm./s.
Boltzmann's constant (k) = 1.380×10^{-16} erg/degree.
Planck's constant (h) = 6.625×10^{-27} erg second.

$$\hbar = \frac{h}{2\pi} = 1.054 \times 10^{-34}$$
 erg second.

Rydberg constant (for nucleus of infinite mass) R_∞ = $2\pi m_e e^4 h^{-3} c^{-1}$
= 109737 cm.⁻¹.

Rydberg constant (for hydrogen) (R_H) = 109677.6 cm.⁻¹.
Volume of 1 gram-molecule (mole) of an ideal at N.T.P. = 22.415 litres (chem. scale).

$$\text{Fine structure constant } \frac{1}{\alpha} = 137.04$$

Calcite grating space, 20° C. (d₂₀) = 3.036×10^{-8} cm.
Atomic radius $\sim 10^{-8}$ cm. Nuclear radius $\sim 10^{-13}$ cm.

URANIUM-RADIUM SERIES ($4n + 2$)

Classical name	Isotope	Particle Emitted	Half value period	Decay constant (λ) (second $^{-1}$)	Parent of	Daughter of
Uranium I (U_I)	$^{238}_{\text{U}}$	α	4.51×10^8 y. 24.10 d.	4.873×10^{-18}	$^{234}_{\text{U}}$ $^{234}_{\text{U}}$	$^{235}_{\text{U}}$
Uranium X_1 (UX_1)	$^{234}_{\text{Ra}}$	β	1.175 m.	9.832×10^{-3}	$^{231}_{\text{U}}$ $^{231}_{\text{U}}$	$^{232}_{\text{U}}$ $^{232}_{\text{U}}$
Uranium X_4 (UX_4)	$^{234}_{\text{Pa}}$	β	6.66 h.	2.891×10^{-5}	$^{231}_{\text{U}}$	$^{232}_{\text{U}}$
Uranium Z (UZ)	$^{234}_{\text{Pa}}$	α	2.48×10^6 y. 8.0×10^4 y.	8.863×10^{-14}	$^{231}_{\text{U}}$	$^{232}_{\text{U}}$
Uranium II (U_{II})	$^{234}_{\text{Ra}}$	α	1.620 y.	2.747×10^{-13}	$^{231}_{\text{U}}$	$^{232}_{\text{U}}$
Ioniun (Io)	$^{234}_{\text{Ra}}$	α	1.357×10^{-11}	Rn	$^{231}_{\text{U}}$	$^{232}_{\text{U}}$
Radium (Ra)	$^{228}_{\text{Ra}}$	α	3.825 d.	2.097×10^{-6}	$^{228}_{\text{Ra}}$	$^{228}_{\text{Ra}}$
Radon (Rn)	$^{222}_{\text{Ra}}$	α	3.05 m.	3.788×10^{-8}	$^{228}_{\text{Ra}}$	$^{228}_{\text{Ra}}$
Radium A (RaA)	$^{222}_{\text{Po}}$	α	26.8 m.	4.311×10^{-4}	$^{228}_{\text{Ra}}$	$^{228}_{\text{Ra}}$
Radium B (RaB)	$^{222}_{\text{Po}}$	β	~ 2 s.	0.3466	$^{228}_{\text{Ra}}$	$^{228}_{\text{Ra}}$
—	$^{222}_{\text{Po}}$	β	19.7 m.	5.864×10^{-4}	$^{228}_{\text{Ra}}$	$^{228}_{\text{Ra}}$
Radium C (RaC)	$^{222}_{\text{Bi}}$	α	0.04 %	0.019 s.	$^{224}_{\text{Ra}}$	$^{224}_{\text{Ra}}$
—	$^{222}_{\text{Rn}}$	α	1.637×10^{-4} s.	36.48	$^{224}_{\text{Ra}}$	$^{224}_{\text{Ra}}$
Radium C' (RaC')	$^{222}_{\text{Po}}$	α	1.32 m.	4.234×10^8	$^{224}_{\text{Ra}}$	$^{224}_{\text{Ra}}$
Radium C ¹ (RaC^{11})	$^{210}_{\text{Ra}}$	β	19 y.	8.752×10^{-3}	$^{224}_{\text{Ra}}$	$^{224}_{\text{Ra}}$
Radium D (RaD)	$^{210}_{\text{Po}}$	β	5.00 d.	1.57×10^{-9}	$^{224}_{\text{Ra}}$	$^{224}_{\text{Ra}}$
—	$^{210}_{\text{Bi}}$	β	138.4 d.	1.605×10^{-6}	$^{210}_{\text{Po}}$	$^{210}_{\text{Po}}$
Radium E (RaE)	$^{210}_{\text{Po}}$	α	4.19 m.	5.797×10^{-8}	$^{210}_{\text{Po}}$	$^{210}_{\text{Po}}$
Polonium (RaF , or Po)	$^{210}_{\text{Po}}$	β	—	2.757×10^{-8}	—	—
—	$^{210}_{\text{Po}}$	Stable	—	—	—	—
Uranium lead (RaG)	—	—	—	—	—	—

THORIUM SERIES ($4n$)

Classical name	Isotope	Particle Emitted	Half value period	Decay constant (λ) (second $^{-1}$)	Parent of	Daughter of
Thorium (Th)	$^{232}_{\text{Th}}$	α	1.39×10^{10} y	1.581×10^{-18}	$^{231}_{\text{MsThI}}$	—
Mesothorium I ($MsThI$)	$^{228}_{\text{Ra}}$	β	6.7 y	3.281×10^{-9}	$^{228}_{\text{MsThI}}$	Th
Mesothorium II ($MsThII$)	$^{228}_{\text{Po}}$	β	6.13 h.	3.141×10^{-6}	$^{228}_{\text{MsThII}}$	MsThI
Radiothorium ($RdTh$)	$^{228}_{\text{Th}}$	α	1.90 y.	1.157×10^{-8}	$^{228}_{\text{ThX}}$	MsThI
Thorium X (ThX)	$^{228}_{\text{Ra}}$	α	3.64 d.	2.204×10^{-6}	$^{228}_{\text{Tn}}$	RdTh
Thorium (Tn)	$^{228}_{\text{Tn}}$	α	54.5 s.	1.272×10^{-2}	$^{228}_{\text{ThA}}$	ThX
Thorium A (ThA)	$^{228}_{\text{Po}}$	α	0.158 s.	4.387	$^{228}_{\text{ThB}}$	Th
—	$^{228}_{\text{At}}$	α	$\sim 3 \times 10^{-4}$ s.	2.311×10^3	$^{228}_{\text{ThC}}$	ThA
Thorium B (ThB)	$^{228}_{\text{Pb}}$	β	10.6 h.	1.816×10^{-5}	$^{228}_{\text{ThC}}$	ThA
Thorium C (ThC)	$^{228}_{\text{Bi}}$	β	60.5 m.	1.910×10^{-4}	$^{228}_{\text{ThC}}$	$^{228}_{\text{ThB}}$
Thorium C' (ThC')	$^{212}_{\text{Po}}$	α	3.04×10^{-7} s.	2.280×10^6	$^{212}_{\text{ThD}}$	ThC
Thorium C ¹ (ThC^{11})	$^{212}_{\text{Ra}}$	β	3.1 m.	3.727×10^{-3}	—	ThC
Thorium lead (ThD)	$^{212}_{\text{Pb}}$	Stable	—	—	—	ThC ¹

ACTINIUM SERIES ($4n + 3$)

Classical name	Isotope	Particle emitted	Half value period	Decay constant (λ) (second $^{-1}$)	Parent of	Daughter of
Actino-Uranium (AcU)	$^{235}_{92}\text{U}$	α	$7 \cdot 13 \times 10^4$ y.	$3 \cdot 083 \times 10^{-17}$	UY	$\overline{\text{AcU}}$
Uranium Y (UY)	$^{231}_{90}\text{Th}$	β	$25 \cdot 64$ h.	$7 \cdot 510 \times 10^{-6}$	Pa	UY
Protactinium (Pa)	$^{231}_{91}\text{Ac}$	β	$3 \cdot 43 \times 10^4$ y.	$6 \cdot 408 \times 10^{-13}$	Ac	Pa
Actinium (Ac)	$^{227}_{89}\text{Ac}$	α	$\{$	$9 \cdot 991 \times 10^{-19}$	RdAc; AcK	
Radioactinium (RdAc)	$^{227}_{88}\text{Th}$	α	22 y.		AcX	
Actinium X (AcX)	$^{228}_{88}\text{Ra}$	α	$18 \cdot 2$ d.	$4 \cdot 408 \times 10^{-7}$	An	Ac
Actinium K (AcK)	$^{228}_{87}\text{Fr}$	α	$11 \cdot 7$ d.	$7 \cdot 163 \times 10^{-7}$	RdAc	
Actinon (An)	$^{228}_{86}(\text{An or Rn})$	$\{$	21 m.	$5 \cdot 501 \times 10^{-4}$	AcX; $^{220}_{85}\text{At}$	
—	$^{220}_{85}\text{At}$	α	$3 \cdot 92$ s.	$1 \cdot 768 \times 10^{-1}$	AcA	AcX
—	$^{220}_{85}\text{At}$	$\{$	$0 \cdot 9$ m.	$\sim 1 \cdot 284 \times 10^{-2}$	$^{226}_{85}\text{Bi}$; An	AcK
—	$^{220}_{85}\text{At}$	β	8 m.	$1 \cdot 444 \times 10^{-4}$	AcA	$^{219}_{85}\text{At}$
Actinium A (AcA)	$^{216}_{85}\text{Bi}$	$\{$	$1 \cdot 83 \times 10^{-3}$ s.	$3 \cdot 788 \times 10^2$	AcB; $^{215}_{85}\text{At}$	$^{215}_{85}\text{Bi}$
$\overline{\text{Ac}}$	$^{216}_{84}\text{Po}$	β	$\{$	$\sim 10^{-4}$ s.	AcC	AcA
Actinium B (AcB)	$^{211}_{85}\text{At}$	α	$36 \cdot 1$ m.	$6 \cdot 932 \times 10^3$	AcC	AcA
Actinium C (AcC)	$^{211}_{85}\text{Po}$	β	$2 \cdot 16$ m.	$3 \cdot 200 \times 10^{-4}$	AcC 211 ; AcC 1	AcB; $^{210}_{85}\text{At}$
Actinium C 1 (AcC 1)	$^{211}_{84}\text{Po}$	α	$0 \cdot 52$ s.	$5 \cdot 348 \times 10^{-3}$	AcC 211	AcC
Actinium C 21 (AcC 21)	$^{211}_{85}\text{Po}$	β	$4 \cdot 79$ m.	$1 \cdot 333$	AcC	AcC
Actinium lead (AcD)	$^{207}_{82}\text{Pb}$	Stable	—	$2 \cdot 412 \times 10^{-8}$	AcD	AcC 1 ; AcC 21

 NEPTUNIUM SERIES ($4n + 1$)

Classical name	Isotope	Particle emitted	Half value period	Decay constant (λ) (second $^{-1}$)	Parent of	Daughter of
	$^{241}_{91}\text{Pu}$	$\{$	13 y.	$1 \cdot 691 \times 10^{-9}$	$^{231}_{92}\text{Am}$	$^{237}_{92}\text{U}$
$^{241}_{92}\text{Am}$	α	$\{$	470 y.	$4 \cdot 677 \times 10^{-11}$	$^{237}_{93}\text{Np}$	$^{241}_{93}\text{Pu}$
$^{237}_{92}\text{U}$	β	$\{$	$6 \cdot 75$ d.	$1 \cdot 189 \times 10^{-6}$	$^{237}_{93}\text{Np}$	$^{241}_{93}\text{Pu}$
$^{237}_{93}\text{Np}$	α	$\{$	$2 \cdot 2 \times 10^6$ y.	$9 \cdot 991 \times 10^{-16}$	$^{233}_{91}\text{Pa}$	$^{237}_{92}\text{U}$
$^{233}_{91}\text{Pa}$	β	$\{$	$27 \cdot 4$ d.	$2 \cdot 928 \times 10^{-7}$	$^{233}_{92}\text{U}$	$^{237}_{93}\text{Np}$
$^{233}_{92}\text{U}$	α	$\{$	$1 \cdot 62 \times 10^5$ y.	$1 \cdot 357 \times 10^{-13}$	$^{229}_{90}\text{Th}$	$^{233}_{91}\text{Pa}$
$^{229}_{90}\text{Th}$	α	$\{$	7340 y.	$2 \cdot 995 \times 10^{-12}$	$^{225}_{88}\text{Ra}$	$^{229}_{90}\text{Th}$
$^{225}_{88}\text{Ra}$	β	$\{$	$14 \cdot 8$ d.	$5 \cdot 421 \times 10^{-7}$	$^{225}_{88}\text{Ac}$	$^{225}_{88}\text{Ra}$
$^{225}_{88}\text{Ac}$	α	$\{$	10 d.	$8 \cdot 023 \times 10^{-7}$	$^{221}_{87}\text{Fr}$	$^{225}_{88}\text{Ac}$
$^{221}_{87}\text{Fr}$	α	$\{$	$4 \cdot 8$ m.	$2 \cdot 407 \times 10^{-3}$	$^{217}_{85}\text{At}$	$^{221}_{87}\text{Fr}$
$^{217}_{85}\text{At}$	α	$\{$	$0 \cdot 018$ s.	$38 \cdot 51$	$^{210}_{83}\text{Bi}$	—
$^{213}_{83}\text{Bi}$	$\{$	β	47 m.	$2 \cdot 458 \times 10^{-4}$	$^{210}_{81}\text{Po}$	$^{217}_{85}\text{At}$
$^{213}_{84}\text{Po}$	α	$\{$	$4 \cdot 2 \times 10^{-6}$ s.	$1 \cdot 650 \times 10^6$	$^{209}_{82}\text{Pb}$	$^{213}_{84}\text{Bi}$
$^{213}_{81}\text{Bi}$	β	$\{$	$2 \cdot 2$ m.	$5 \cdot 231 \times 10^{-3}$	$^{209}_{82}\text{Pb}$	$^{213}_{83}\text{Bi}$
$^{209}_{82}\text{Pb}$	β	$\{$	$3 \cdot 3$ h.	$5 \cdot 835 \times 10^{-6}$	$^{209}_{80}\text{Bi}$	$^{209}_{84}\text{Po}$
$^{209}_{80}\text{Bi}$	Stable	—	—	—	—	—

MEAN RANGES IN AIR OF α -PARTICLES OF
THE PRINCIPAL NATURAL α -EMITTERS
(at 15° C. and 760 mm. Hg.)

Th	2.48 cm.	U ₁	2.70 cm.	AcU	{ 2.9 cm. 3.08 "
RdTh	3.98 "	U ₁₁	3.26 "	Pa	{ 3.52 " 3.2 "
ThX	4.26 "	Io	3.17 "	Ac	3.46 "
Tn	5.00 "	Ra	3.28 "	RdAc	{ 4.65 " 4.30 "
ThA	5.62 "	Rn	4.06 "	AcX	4.32 "
At ²¹⁶	6.93 "	RaA	4.65 "	An	5.64 "
ThC	4.76 "	At ²¹⁸	5.52 "	AcA	6.44 "
ThC ¹	8.54 "	RaC	4.0 "	At ²¹⁵	7.7 "
		RaC ¹	6.88 "	At ²¹⁹	4.9 "
		Po	3.84 "	AcC	5.42 "
				AcC ¹	6.53 "
Sm ¹⁴⁷	1.05 "				

TABLE OF ISOTOPES AND
RELATIVE ABUNDANCE OF
THE ELEMENTS

The number of protons in a nucleus is usually designated by Z and is called the *atomic number*. Since the normal atom is electrically neutral, it must contain an equal number of planetary electrons. The chemical properties are determined by the number and arrangement of the electrons and hence the atomic number decides the behaviour of a given atom, i.e. determines which element it is.

The number of neutrons in a nucleus is usually designated by N. The sum, N + Z, represents the total number of protons and neutrons in a nucleus and is known as the *mass number*, A.

Atoms which have the same atomic number (i.e. exhibit identical chemical properties) but which have different mass numbers are called *isotopes*.

In the following table the isotopes whose mass numbers are printed in bold-face type occur naturally and if they are radioactive this is shown by an asterisk (*). All other isotopes are artificial and are radioactive. The percentage abundance of the natural isotopes is given in parenthesis after the appropriate mass number.

Where no stable isotope of an element is known, the mass number of the longest-lived isotope in the atomic weight column is shown in brackets, e.g. Technetium [99].

TABLE OF ISOTOPES (continued)

Atomic number	Element	Symbol	Atomic weight (C=12.00)	Mass numbers of the isotopes
1	Hydrogen	H	1.0080	1 (99.985%), 2 (0.015%), 3
2	Helium	He	4.003	3 (~10 ⁻⁴ %), 4 (~100%), 5
3	Lithium	Li	6.940	6 (7.52%), 7 (92.48%), 8, 9
4	Beryllium	Be	9.013	7, 8, 9 (100%), 10
5	Boron	B	10.81	8, 9, 10 (~18.5%), 11 (~81.5%), 12
6	Carbon	C	12.00	10, 11, 12 (98.892%), 13 (1.108%), 14, 15
7	Nitrogen	N	14.007	12, 13, 14 (99.635%), 15 (0.365%), 16, 17
8	Oxygen	O	15.999	14, 15, 16 (99.759%), 17 (0.037%), 18 (0.204%), 19
9	Fluorine	F	19.000	17, 18, 19 (100%), 20, 21
10	Neon	Ne	20.183	18, 19, 20 (99.92%), 21 (0.257%), 22 (8.827%), 23
11	Sodium	Na	22.990	20, 21, 22, 23 (100%), 24, 25
12	Magnesium	Mg	24.31	23, 24 (78.60%), 25 (10.11%), 26 (11.29%), 27, 28
13	Aluminium	Al	26.98	24, 25, 26, 27 (100%), 28, 29
14	Silicon	Si	28.09	27, 28 (92.27%), 29 (4.68%), 30 (3.05%), 31, 32
15	Phosphorus	P	30.974	28, 29, 30, 31 (100%), 32, 33, 34
16	Sulphur	S	32.064	31, 32 (95.018%), 33 (0.750%), 34 (4.215%), 35, 36, 37
17	Chlorine	Cl	35.453	32, 33, 34, 35 (75.4%), 36, 37 (24.60%), 38, 39
18	Argon	A	39.948	35, 36 (0.337%), 37, 38 (0.063%), 39, 40 (99.6%), 41, 42
19	Potassium	K	39.102	37, 38, 39 (92.08%), 40* (0.0119%), 41 (6.911%), 42, 43, 44
20	Calcium	Ca	40.08	39, 40 (96.97%), 41, 42 (0.64%), 43 (0.145%), 44 (2.06%), 45, 46 (0.0033%), 47, 48 (0.185%), 49
21	Scandium	Sc	44.956	40, 41, 43, 44, 45 (100%), 46, 47, 48, 49
22	Titanium	Ti	47.90	43, 44, 45, 46 (7.95%), 47 (7.75%), 48 (73.45%), 49 (5.51%), 50 (5.34%), 51
23	Vanadium	V	50.94	46, 47, 48, 49, 50 (0.24%), 51 (99.76%), 52, 53
24	Chromium	Cr	52.00	48, 49, 50 (4.31%), 51, 52 (83.76%), 53 (9.55%), 54 (2.38%), 55
25	Manganese	Mn	54.93	50, 51, 52, 54, 55 (100%), 56, 57
26	Iron	Fe	55.85	52, 53, 54 (5.84%), 55, 56 (91.68%), 57 (2.17%), 58 (0.31%), 59, 60
27	Cobalt	Co	58.93	54, 55, 56, 57, 58, 59 (100%), 60, 61, 62, 64
28	Nickel	Ni	58.71	56, 57, 58 (67.76%), 59, 60, (26.16%), 61 (1.25%), 62 (3.66%), 63, 64 (1.16%), 65, 66
29	Copper	Cu	63.54	58, 59, 60, 61, 62, 63 (69.1%), 64, 65 (30.9%), 66, 67
30	Zinc	Zn	65.37	62, 63, 64 (48.89%), 65, 66 (27.81%), 67 (4.11%), 68 (18.56%), 69, 70 (0.62%), 71, 72, 64, 65, 66, 67, 68, 69 (60.2%), 70, 71 (39.8%), 72, 73
31	Gallium	Ga	69.72	66, 67, 68, 69, 70 (20.55%), 71, 72 (27.37%), 73 (7.67%), 74 (36.74%), 75, 76 (7.67%), 77, 78
32	Germanium	Ge	72.59	

TABLE OF ISOTOPES (continued)

Atomic number	Element	Symbol	Atomic weight (C=12.00)	Mass numbers of the isotopes
33	Arsenic	As	74.92	69, 70, 71, 72, 73, 74, 75 (100%), 76, 77, 78, 79
34	Selenium	Se	78.96	70, 72, 73, 74 (0.87%), 75, 76 (0.2%), 77 (7.58%), 78 (23.52%), 79, 80 (49.82%), 81, 82 (9.19%), 83, 84
35	Bromine	Br	79.909	74, 75, 76, 77, 78, 79 (50.52%), 80, 81 (49.48%), 82, 83, 84, 85, 87, 88, 89
36	Krypton	Kr	83.80	76, 77, 78 (0.354%), 79, 80 (2.27%), 81, 82 (11.56%), 83 (11.55%), 84 (56.90%), 85, 86 (17.37%), 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97
37	Rubidium	Rb	85.47	81, 82, 83, 84, 85 (72.15%), 86, 87* (27.85%), 88, 89, 90, 91, 92, 93, 94, 95, 97
38	Strontium	Sr	87.62	81, 82, 83, 84 (0.563%), 85, 86 (0.86%), 87 (7.02%), 88 (82.56%), 89, 90, 91, 92, 93, 94, 95, 97
39	Yttrium	Y	88.90	82, 83, 84, 85, 86, 87, 88, 89 (100%), 90, 91, 92, 93, 94, 95, 97
40	Zirconium	Zr	91.22	86, 87, 88, 89, 90 (51.46%), 91 (11.23%), 92 (17.11%), 93, 94 (17.4%), 95, 96 (2.8%), 97
41	Columbium	Cb	92.91	89, 90, 91, 92, 93 (100%), 94, 95, 96, 97, 98, 99
42	Niobium	Nb	95.94	90, 91, 92 (15.86%), 93, 94 (9.12%), 95 (15.70%), 96 (16.58%), 97 (9.45%), 98 (23.75%), 99, 100 (9.62%), 101, 102, 105
43	Technetium	Tc	[99]	92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107
44	Ruthenium	Ru	101.7	94, 95, 96 (5.7%), 97, 98 (2.2%), 99 (12.8%), 100 (12.7%), 101 (17.0%), 102 (31.3%), 103, 104 (18.3%), 105, 106, 107
45	Rhodium	Rh	102.90	95, 97, 98, 99, 100, 101, 102, 103 (100%), 104, 105, 106, 107, 109
46	Palladium	Pd	106.4	100, 101, 102 (0.8%), 103, 104 (9.3%), 105 (22.6%), 106 (27.2%), 107, 108 (26.8%), 109, 110 (13.5%), 111, 112, 113
47	Silver	Ag	107.870	102, 103, 104, 105, 106, 107 (51.35%), 108, 109 (48.65%), 110, 111, 112, 113, 114, 115
48	Cadmium	Cd	112.40	104, 105, 106 (1.215%), 107, 108 (0.875%), 109, 110 (12.39%), 111 (12.75%), 112 (24.67%), 113 (12.24%), 114 (28.86%), 115, 116 (7.58%), 117, 118
49	Indium	In	114.82	107, 108, 109, 110, 111, 112, 113 (4.23%), 114, 115* (95.77%),
50	Tin	Sn	118.69	108, 111, 112 (0.95%), 113, 114 (0.65%), 115 (0.34%), 116 (14.24%), 117 (7.57%), 118 (24.01%), 119 (8.58%), 120 (32.97%), 121, 122 (4.71%), 123 (2.59%), 124 (5.98%), 125, 126, 127

TABLE OF ISOTOPES (continued)

Atomic number	Element	Symbol	Atomic weight (C=12.00)	Mass numbers of the isotopes
51	Antimony	Sb	121.75	116, 117, 118, 119, 120, 121 (57-25%), 122, 123 (42-75%), 124, 125, 126, 127, 129, 130, 131, 132, 133, 134, 135
52	Tellurium	Te	127.60	117, 118, 119, 120 (0.089%), 121, 122 (2.46%), 123 (0.87%), 124 (4.61%), 125 (6.99%), 126 (18.71%), 127, 128 (31.79%), 129, 130 (34.49%), 131, 132, 133, 134, 135
53	Iodine	I	126.90	119, 120, 121, 122, 123, 124, 125, 126, 127 (10.0%), 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139
54	Xenon	Xe	131.3	121, 122, 123, 124 (0.096%), 125, 126 (0.09%), 127, 128 (1.919%), 129 (26.44%), 130 (4.08%), 131 (21.18%), 132 (26.89%), 133, 134 (16.44%), 135, 136 (8.87%), 137, 138, 139, 140, 141, 143, 144
55	Caesium	Cs	132.90	123, 125, 126, 127, 128, 129, 130, 131, 132, 133 (800%), 134, 135, 136, 137, 138, 139, 141, 142, 143, 144
56	Barium	Ba	137.34	126, 127, 128, 129, 130 (0.101%), 131, 132 (0.097%), 133, 134 (2.42%), 135 (6.59%), 136 (7.81%), 137 (11.32%), 138 (71.66%), 139, 140, 141, 142, 143, 144
57	Lanthanum	La	138.91	131, 132, 133, 134, 135, 136, 137, 138* (0.089%), 139 (99.911%), 140, 141, 142, 143, 144
58	Cerium	Ce	140.12	133, 134, 135, 136 (0.193%), 137, 138 (0.25%), 139, 140 (88.48%), 141, 142 (11.07%), 143, 144, 146
59	Praseodymium	Pr	140.91	135, 136, 137, 138, 139, 140, 141 (100%), 142, 143, 144, 146
60	Neodymium	Nd	144.24	138, 139, 140, 141, 142 (27.13%), 143 (12.20%), 144 (23.87%), 145 (8.30%), 146 (17.18%), 147, 148 (5.72%), 149, 150* (5.10%), 151
61	Promethium	Pm	[147]	141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151
62	Samarium	Sm	150.35	143, 144 (3.16%), 145, 147* (15.07%), 148 (11.27%), 149 (13.84%), 150 (7.47%), 151, 152 (26.63%), 153, 154 (22.53%), 155, 156
63	Europium	Eu	152.0	144, 145, 146, 147, 148, 149, 150, 151 (47.77%), 152, 153 (52.23%), 154, 155, 156, 157, 158, 159
64	Gadolinium	Gd	157.25	148, 149, 150, 151, 152 (0.20%), 153, 154 (2.15%), 155 (14.73%), 156 (20.47%), 157 (15.68%), 158 (24.87%), 159, 160 (21.90%), 161 (100%), 162, 163 (2.294%), 161 (18.88%), 162 (25.53%), 163 (24.97%), 164 (28.18%), 165, 166
65	Terbium	Tb	158.92	
66	Dysprosium	Dy	162.50	

TABLE OF ISOTOPES (continued)

Atomic number	Element	Symbol	Atomic weight (C=12.00)	Mass numbers of the isotopes
67	Holmium	Ho	164.93	160, 161, 162, 163, 164, 165 (100%), 166
68	Erbium	Er	167.26	160, 161, 162 (0.136%), 163, 164 (1.56%), 165, 166 (33.41%), 167 (22.94%), 168 (27.07%), 169, 170 (14.88%), 171
69	Thulium	Tm	168.93	165, 166, 167, 168, 169 (100%), 170, 171, 172
70	Ytterbium	Yb	173.04	166, 168 (0.14%), 169, 170 (3.03%), 171 (14.31%), 172 (21.82%), 173 (16.13%), 174 (31.84%), 175, 176 (12.73%), 177
71	Lutetium	Lu	174.97	170, 171, 172, 173, 174, 175 (97.9%), 176 (2.6%), 177
72	Hafnium	Hf	178.49	170, 171, 172, 173, 174 (9.18%), 175, 176 (5.15%), 177 (18.39%), 178 (27.08%), 179 (13.78%), 180 (35.44%), 181
73	Tantalum	Ta	180.95	176, 177, 178, 179, 180* (0.0123%), 181 (99.988%), 182, 183, 184, 185
74	Wolfram (Tungsten)	W	183.85	176, 177, 178, 179, 180 (0.135%), 181, 182 (2.64%), 183 (14.4%), 184 (30.6%), 185, 186 (28.4%), 187, 188
75	Rhenium	Re	186.20	180, 182, 183, 184, 185 (37.07%), 186, 187* (62.93%), 188, 189
76	Osmium	Os	190.2	182, 183, 184 (0.018%), 185, 186 (1.59%), 187 (1.64%), 188 (13.3%), 189 (16.1%), 190 (26.4%), 191, 192 (41.0%), 193, 194
77	Iridium	Ir	192.2	187, 188, 190, 191 (38.5%), 192, 193 (61.5%), 194, 195, 196, 197, 198
78	Platinum	Pt	195.09	188, 190* (0.012%), 191, 192 (0.78%), 193, 194 (32.8%), 195 (33.7%), 196 (25.4%), 197, 198 (7.23%), 199
79	Gold	Au	197.0	191, 192, 193, 194, 195, 196, 197 (100%), 198, 199, 200, 201, 202, 203, 204
80	Mercury	Hg	200.59	189, 190, 191, 192, 193, 194, 195, 196 (0.146%), 197, 198 (10.02%), 199 (16.84%), 200 (23.13%), 201 (13.22%), 202 (29.80%), 203, 204 (6.85%), 205
81	Thallium	Tl	204.37	196, 197, 198, 199, 200, 201, 202, 203 (29.5%), 204, 205 (70.5%), 206, 207* (AcC*), 208* (ThC*), 209, 210* (RaC*), 211* (RaD), 211* (AcB), 212* (ThB), 214* (RaB)
82	Lead	Pb	207.19	198, 199, 200, 201, 203, 204 (1.48%), 206 (23.6%), 207 (22.6%), 208 (52.3%), 209, 210* (RaD), 211* (AcB), 212* (ThB), 213, 214* (RaC), 215
83	Bismuth	Bi	208.98	198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 209 (100%), 210* (RaE), 211* (AcC), 212* (ThC), 213, 214* (RaC), 215

TABLE OF ISOTOPES (continued)

Atomic number	Element	Symbol	Atomic weight (C=12.00)	Mass numbers of the isotopes
84	Polonium	Po	[210]	200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210 ^o , 211 ^o (AcC), 212 ^o (ThC ^o), 213, 214 ^o (RaC ^o), 215 ^o (AcA), 216 ^o (ThA), 217, 218 (RaA)
85	Astatine	At	[210]	203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215 ^o , 216 ^o , 217, 218 ^o , 219 ^o
86	Radon	{Rn} {Em}	[222]	208, 209, 210, 211, 212, 215, 216, 217, 218, 219 ^o (Rn), 220 ^o (Tn), 221, 222 ^o (Rn)
87	Francium	Fr	[223]	211, 212, 217, 218, 219, 220, 221, 222, 223 ^o (Ack)
88	Radium	Ra	226-05	213, 219, 220, 221, 222, 223 ^o (AcX), 224 ^o (ThX), 225, 226 ^o , 227, 228 ^o (MsThi), 229, 230
89	Actinium	Ac	227	221, 222, 223, 224, 225, 226, 227 ^o , 228 ^o (MsTh2), 229, 230
90	Thorium	Th	232-04	223, 224, 225, 226, 227 ^o (RdAc), 228 ^o (RdTl), 229, 230 ^o (Io), 231 ^o (UY), 232 ^o , 233, 234 ^o (OXI), 235
91	Protactinium	Pa	[231]	225, 226, 227, 228, 229, 230, 231 ^o , 232, 233, 234 ^o (UX2), 234 ^o (UZ), 235, 237
92	Uranium	U	238-03	227, 228, 229, 230, 231, 232, 233, 234 ^o (UII), 235 ^o (AcU), 236, 237, 238 ^o (UJ), 239, 240
93	Neptunium	Np	[237]	231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241
94	Plutonium	Pu	[242]	232, 234, 235, 236, 237, 238, 239(f), 240, 241, 242, 243, 244
95	Americium	Am	[243]	237, 238, 239, 240, 241, 242, 243, 244
96	Curium	Cm	[247]	238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248
97	Berkelium	Bk	[247]	243, 244, 245, 246, 247, 249
98	Californium	Cf	[249]	244, 245, 246, 247, 248, 249, 250, 251, 252, 253
99	Einsteinium	E	[254]	246, 247, 253, 254, 255
100	Fermium	Fm	[253]	254, 255, 256
101	Mendelevium	Mv	[256]	256
102	Nobelium	No	[253]	
103	Lawrencium	Lw	[257]	

(f) This isotope has been found in pitchblende in a concentration of 1 part in 10^{12} .

THE PARTICLES OF MODERN PHYSICS

Name	Symbol	Rest mass (electron mass = 1)	Lifetime	Mode of decay	First observer	Description
Photon	$\hbar\nu$	0	Stable	—	Postulated by Planck in 1901 to account for observed energy distribution of thermal radiation. Used by Einstein 1905 to explain the photoelectric effect discovered by Hertz in 1887.	The quantum of radiation or particle of radiant energy. $E = h\nu$, where h is Planck's constant and ν = frequency of the electromagnetic radiation.
Neutrino	ν_0	Probably 0. Certainly less than 0.0004	—	—	Anderson <i>et al.</i> , 1932. Postulated by Dirac, 1931 on theoretical grounds.	For 25 years a hypothetical neutral particle invoked to conserve energy and momentum in β -decay. Name proposed by Fermi. Experimentally detected 1956 by Reines and Cowan through the reaction $p + v_0 \rightarrow n_0 + e^+$
Electron	e^-	1	Stable	—	J. J. Thomson, 1897.	Negatively charged particle. On Bohr model of atom, electrons revolve in orbits round the central nucleus.
Positron	e^+	1	Stable (see description)	—	Anderson <i>et al.</i> , 1932. Postulated by Dirac, 1931 on theoretical grounds.	Similar to electron but bears positive charge. Interacts strongly with and is annihilated by combination with a negative electron producing two oppositely directed quanta each of which has energy = 511 keV . $e^- + e^+ \rightarrow 2\gamma$.

THE PARTICLES OF MODERN PHYSICS (continued)

Name	Symbol	Rest mass electron mass = 1	Lifetime	Mode of decay	First observer	Description
LIGHT (L) MESONS						
μ meson	μ^+ μ^-	207	$2 \cdot 10^{-6}$ s. $2 \cdot 10^{-8}$ s.	$\mu^+ \rightarrow e^+ + 2\pi_0$ $\mu^- \rightarrow e^- + 2\pi_0$	Anderson <i>et al.</i> , 1936-38.	Observed first in cosmic radiation. Is found in decay of mesons. May be captured if stops close to heavy nucleus causing disruption thereof. Charged α -mesons particularly π^+ , interact strongly with nuclei causing the disruption thereof. First observed in cosmic radiation, they can now be produced artificially by high energy accelerators.
π meson	π^+ π^- π^0	273 273 264	$2 \cdot 10^{-6}$ s. $2 \cdot 10^{-8}$ s. 5×10^{-14} s.	$\pi^+ \rightarrow \mu^+ + \nu_0$ $\pi^- \rightarrow \mu^- + \nu_0$ $\pi^0 \rightarrow 2\pi_0$	Lattes, Muirhead, Occhipinti and Powell, 1947. Bjorklund <i>et al.</i> , 1950. (Mesons having similar properties to mesons were postulated on theoretical grounds by Yukawa in 1935.)	

K PARTICLES

ρ meson	π^+ π^-	$\sim 1.0 \times 10^{-8}$ s.	$\begin{cases} \pi^+ \rightarrow 2\pi^+ + \pi^- \\ \pi^- \rightarrow 2\pi^0 + \pi^+ \end{cases}$ (in flight)	Brown <i>et al.</i> , 1949	
ρ meson (formerly Σ^0 -meson)	θ_0 θ_0^+	0.66×10^{-10} s. $\sim 10^{-8}$ s.	$\theta^0 \rightarrow \pi^+ + \pi^0$ $\theta^+ \rightarrow \pi^+ + \pi^0$	Menon <i>et al.</i> , 1952	
$K\mu^+$ -meson	$K\mu^+$	9.0×10^{-8} s.	$K\mu^+ \rightarrow \mu^+ + \nu_0$	Gregory <i>et al.</i> , 1954	
$K\beta^+$ -meson	$K\beta^+$	9×10^{-8} s.	$K\beta^+ \rightarrow e^+ + 2$ neutral particles	Friedlander <i>et al.</i> , 1954	
ρ meson	π^+	$\sim 10^{-8}$ s.	$\pi^+ \rightarrow \mu^+ + 2$ neutral particles	O'Ceallaigh, 1951	

NUCLEONS

Proton	p^+	1836	Stable	—	Rutherford, 1911; Marsden, 1913
Neutron	n_0	1838	12 m.	Chadwick, 1932	
ANTINUCLEONS					

Antiproton	p^-	1836 ± 40	Stable in vacuum	Annihilates with p^+	Chamberlain <i>et al.</i> , 1955; 56	The antiprotons have the same mass as the ordinary particles but opposite charge (where appropriate) and opposite magnetic moment, τ component of the isotopic spin, etc.
Antineutron	n_0	~ 1838	—	—	—	

HYPERONS

Λ -meson (formerly called Σ_1^0 meson)	Λ_0	2182 ± 0.4	3.4×10^{-10} s.	$\Lambda_0 \rightarrow p^+ + \pi^-$	Armenteros <i>et al.</i> , 1951	Hyperon is the name given to all particles of mass intermediate to that of the neutron and deuteron.
Σ -meson	Σ^+ Σ^- Ξ^-	2327 ± 1 2340 2585 ± 6	0.3×10^{-10} s. 1.4×10^{-10} s. $\sim 10^{-10}$ s.	$\Sigma^+ \rightarrow \pi^+ + \nu_0$ $\Sigma^- \rightarrow p^+ + \pi^0$ $\Xi^- \rightarrow A_0 + \pi^-$	Bonetti <i>et al.</i> , 1953 York <i>et al.</i> , 1953 Shutt <i>et al.</i> , 1954 Cowan <i>et al.</i> , 1954	
Ξ -meson						

ENERGY EQUIVALENTS

Einstein's relation $E = mc^2$ relates mass and energy with the square of the speed of light as the constant of proportionality. Thus the energy equivalent of 1 g. of any substance is 8.988×10^{20} ergs = 8.988×10^{13} joules = 2.497×10^7 kilowatt-hours. This amount of energy would be liberated if 1 g. of matter was annihilated.

It is often convenient to consider energies in terms of electron-volts (e.v.). One electron volt is the energy gained by any singly charged particle (such as an electron) in falling through a potential difference of 1 volt.

One volt = 10^8 e.m.u. of potential and the electronic charge is 1.602×10^{-20} e.m.u. So the energy of 1 e.v. = $10^8 \times 1.602 \times 10^{-20} = 1.602 \times 10^{-12}$ erg.

$$1 \text{ k.e.v.} = 1000 \text{ e.v.} \quad 1 \text{ M.e.v.} = 10^6 \text{ e.v.}$$

For gas atoms in thermal equilibrium with one another the energy per degree of freedom is $\frac{1}{2}kT$, where k is Boltzmann's constant and T is the absolute temperature. For an atom with three degrees of freedom, the energy is $\frac{3}{2}kT$. For molecules there are more than three degrees of freedom in general. This relation is not valid for temperatures near the absolute zero where quantum considerations enter. In chemistry and in thermodynamics energies are often in terms of kT . In the table below the energy equivalent of one degree absolute is calculated from $E = kT$.

The table given on p. 155 is suitable for converting most of the commonly encountered energy units. It gives equivalent quantities in horizontal lines. Thus 1 g. = 8.988×10^{20} ergs = 1.098×10^{27} electron masses = 6.025×10^{28} a.m.u. = 5.610×10^{26} M.e.v. = 6.511×10^{36} deg. abs. etc.

The table may be further extended to include the energy-frequency and the energy-wave number relation of photons through $E = hv$ and $E = hc\left(\frac{1}{\lambda}\right)$, where $\frac{1}{\lambda}$ is the wave number. Thus a photon of unit frequency has an energy of 6.625×10^{-27} erg while one having unit wave number has an energy of 1.986×10^{-16} erg.

ENERGY EQUIVALENTS

	Ergs	Grams	Electron masses	a.m.u.	M.e.v.	Degrees absolute	Calories	K.W.H.
1 erg =	1	8.988×10^{-21}	1.222×10^6	6.704×10^3	6.242×10^2	7.244×10^{15}	2.389×10^{-8}	2.778×10^{-14}
1 gram =		1	1.098×10^{-21}	6.025×10^{28}	5.610×10^{30}	6.311×10^{35}	2.147×10^{13}	2.497×10^7
1 electron mass =		8.186×10^{-7}	1	5.488×10^{-4}	0.5110	5.930×10^6	1.956×10^{-14}	2.274×10^{-20}
1 a.m.u. =		1.492×10^{-7}	1.660×10^{-21}	1822	1	931.1	1.081×10^{13}	3.564×10^{-11}
1 M.e.v. =		1.602×10^{-8}	1.783×10^{27}	1.957	1.074×10^{-3}	1	1.161×10^{10}	3.828×10^{-14}
1 deg. abs. =		1.380×10^{-16}	1.536×10^{-27}	1.686×10^{-16}	9.254×10^{-11}	8.617×10^{-11}	3.298×10^{-11}	3.835×10^{-22}
1 calorie =		4.186×10^7	4.657×10^{-11}	5.113×10^{15}	2.806×10^{10}	2.613×10^{13}	3.032×10^{14}	1.163×10^{-6}
1 K.W.H. =		3.600×10^{13}	4.006×10^{-8}	4.398×10^{16}	2.413×10^{15}	2.347×10^{13}	2.608×10^{22}	8.601×10^3
								1

OPTICAL DATA

REFRACTIVE INDEX OF GASES

for D line = 5893 Å.

Acetylene	1.000606	Hydrogen	1.000138
Air	1.000292	Hydrogen chloride	1.000447
Ammonia	1.000375	Hydrogen sulphide	1.000630
Argon	1.000281	Methane	1.000441
Carbon dioxide	1.000450	Nitric oxide	1.000297
Carbon monoxide	1.000334	Nitrous oxide	1.000515
Chlorine	1.000768	Nitrogen	1.000297
Cyanogen	1.000800	Oxygen	1.000272
Ethylene	1.000674	Sulphur dioxide	1.000660
Helium	1.000036	Water vapour	1.000254

REFRACTIVE INDICES (AGAINST AIR) FOR MEAN D LINE

$\lambda = 5893 \times 10^{-8}$ cm.

Canada Balsam	1.53	Iceland Spar (ord.)	1.658
Crown Glass	1.48-1.61	Iceland Spar (ext.)	1.486
Diamond	2.417	Quartz (ord.)	1.544
Felspar	1.52	Quartz (ext.)	1.553
Flint Glass	1.53-1.96	Rock Salt	1.544
Fluorspar	1.434	Ruby	1.76
Ice	1.31	Sylvine (KCl)	1.490
Water	1.333	Perspex	1.495

WAVELENGTHS OF IMPORTANT SPECTRAL LINES IN AIR AT 15° C. AND 760 mm.

$\text{Å.} = 10^{-8}$ cm. = Ångström unit

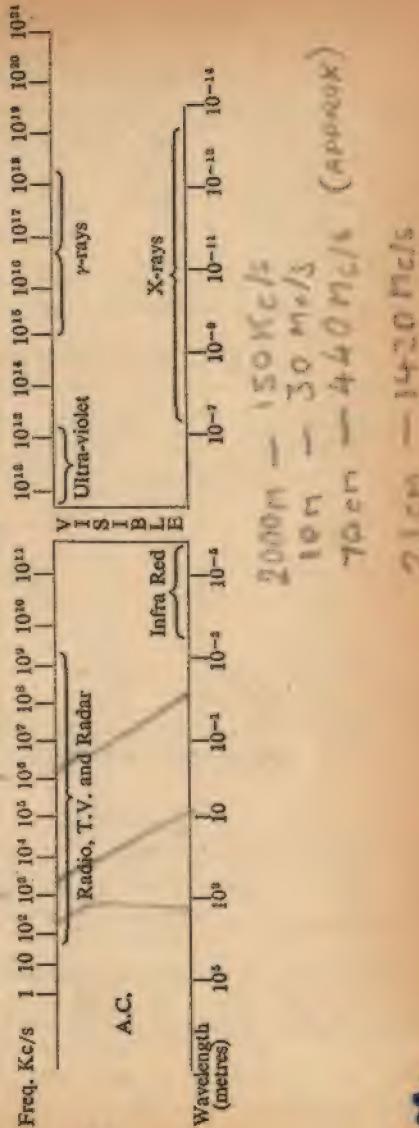
Line	Wavelength Å.	Line	Wavelength Å.
K red	7668	Mg green	5178
O red (A)	7594	(b_1)	5173
O red (B)	6870	(b_2)	5167
Li red	6708	Cd green*	5085.82
He red (C)	6563	$H\beta$ blue-green (F)	4861
Cd red*	6438-4696	Cd blue*	4799.91
Li orange	6104	Sr blue	4608
Na orange (D ₁)	5895.9	Li blue	4602
Na orange (D ₂)	5890.0	$H\gamma$ blue (G ¹)	4340
He yellow (D ₃)	5875.6	Fe and Ca blue (G)	4308
Ti green	5351	Ca blue (g)	4227
Fe and Ca green (E)	5270	K violet	4047

* Accepted standard lines

Rydberg's Constant - Hydrogen, 109677.58; Helium, 109722.27

Velocity of Light in Vacuum (c) = 299793 ± 0.5 km./s.

THE ELECTROMAGNETIC SPECTRUM



ACOUSTIC DATA

VELOCITY OF SOUND

Substance	Temp.	m./s.	ft./s.	Substance	m./s.	ft./s.
Air	0° C.	331.3	1087	Aluminium	5100	16730
Hydrogen	0° C.	1270.0	4166	Brass	3500	11480
Oxygen	0° C.	317	1040	Copper	3600	11810
Water	20° C.	1410	4626	Iron	5000	16400
Oak (along fibre)	10°-20° C.	3850	12630	Lead	1200	4265
Glass	10°-20° C.	5000-6000	16400-19700	Mercury	1452	4764

LOUDNESS OF SOUNDS

Intensity in terms of threshold-intensity = .0002 dyne per cm. ²	Intensity in decibels	Loudness in phons
1	0	0 Threshold of hearing
10 ¹	10 (1 bel)	10 Virtual silence
10 ²	20	20 Quiet room
10 ³	30	30 Watch ticking at 3 ft.
10 ⁴	40	40 Quiet street
10 ⁵	50	50 Quiet conversation
10 ⁶	60	60 Quiet motor at 3 ft.
10 ⁷	70	70 Loud conversation
10 ⁸	80	80 Door slamming
10 ⁹	90	90 Busy typing room
10 ¹⁰	100	100 Near loud motor horn
10 ¹¹	110	110 Pneumatic drill
10 ¹²	120	120 Near aeroplane engine
10 ¹³	130	130 Threshold of pain

Limits of Audibility - Between 30 and 30,000 c/s. (approximately).

MUSIC

The consonant frequency intervals.

Name	Octave	Fifth	Fourth	Major Third	Major Sixth	Minor Third	Minor Sixth
Frequency Ratio	1:2	2:3	3:4	4:5	3:5	5:6	5:8

Musical Scales - Vibration Ratios

Basic Scale }	C	D	B	F	G	A	B	C
	24	27	30	32	36	40	43	48
Scale	1.000	1.125	1.250	1.333	1.500	1.667	1.875	2.000

Intervals	—	9/8	10/9	16/15	9/8	10/9	9/8	16/15
	—	9/8	10/9	16/15	9/8	10/9	9/8	16/15

* The Basic Scale is frequently referred to as the Natural or Diatonic Scale.

GEOMETRICAL MENSURATIONS

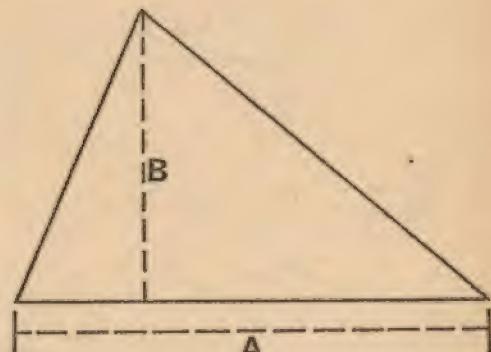
(Illustrated)

LENGTH

WIDTH

Area of Rectangle

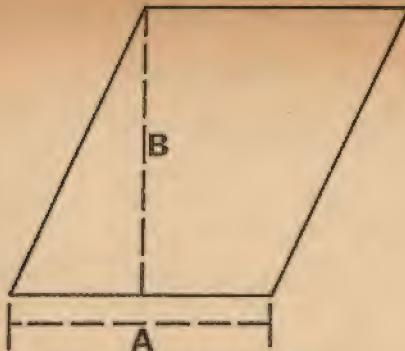
Area of rectangle equals LENGTH \times WIDTH.



Area of Triangle

Area of any triangle equals the length of the base multiplied by half the vertical height.

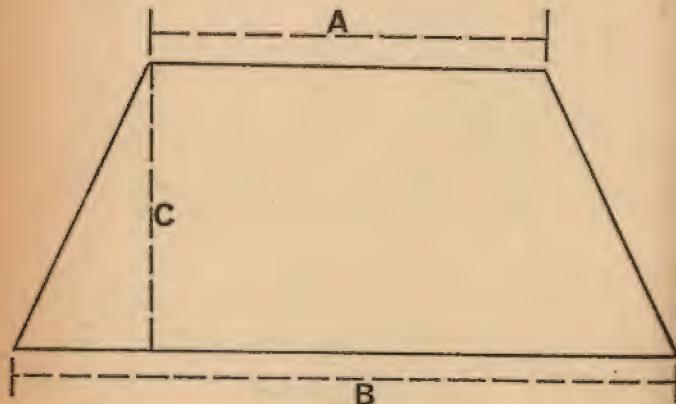
i.e. If A equals length of base and B equals vertical height, area equals $\frac{A \times B}{2}$.



Area of Parallelogram

Area of a parallelogram equals the length of one of the sides multiplied by the perpendicular height.

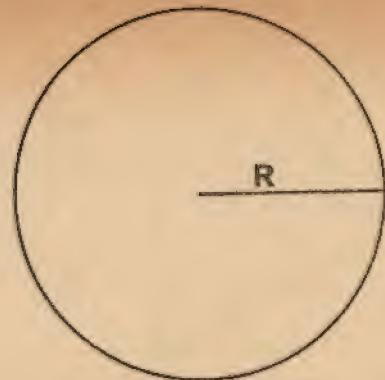
i.e. If A equals length of one side and B equals perpendicular height, area equals $A \times B$.



Area of Trapezoid

Area of a trapezoid equals half the sum of the two parallel sides multiplied by the perpendicular distance between them.

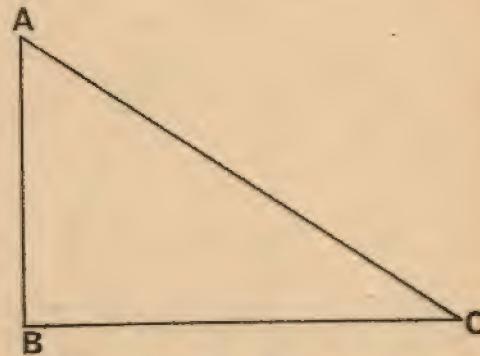
i.e. If A and B equal the lengths of the two parallel sides and C equals the perpendicular distance between them, area equals $\frac{A + B}{2} \times C$.



Area of Circle

Area of a circle is proportional to the square of its radius.

i.e. If R equals the radius of the circle, area equals πR^2 (π , a constant quantity = $\frac{22}{7}$ or 3.1416).

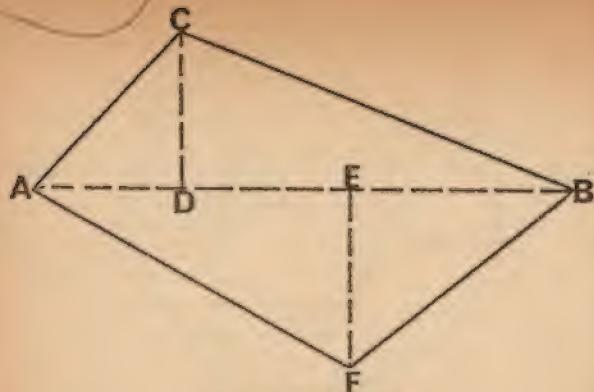


Determination of Height, Base, or Hypotenuse of a Right-angled Triangle

If AB = height, BC = base, and AC = hypotenuse, when two dimensions are given:

$$\text{Base} = \sqrt{AC^2 - AB^2} \quad \text{Height} = \sqrt{AC^2 - BC^2}$$

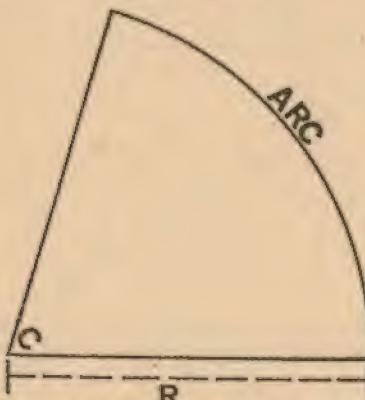
$$\text{Hypotenuse} = \sqrt{BC^2 + AB^2}$$



Area of Trapezium

Area of a trapezium equals the length of the diagonal multiplied by half the sum of the perpendiculars let fall upon it from its opposite angles.
i.e. If AB equals the length of the diagonal and $CD + EF$ equals the sum of the perpendiculars to the opposite angles, area equals

$$AB \times \frac{CD + EF}{2}$$

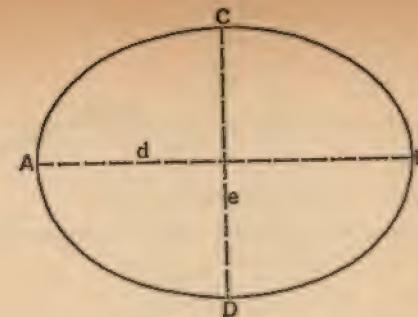


Area of Sector of Circle

Area of sector of circle equals area of the full circle multiplied by the degrees in ARC and divided by 360.

i.e. If R equals radius and C equals degrees in ARC, area equals

$$\frac{R^2 \times \pi \times C}{360}$$



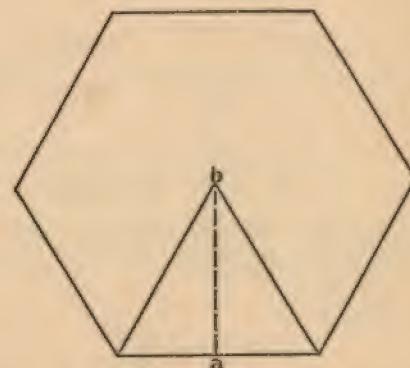
Area of Ellipse

Area of an ellipse equals half the larger axis multiplied by half the smaller axis and multiplied by π .

i.e. If AB be the larger axis and d be half of it; and if CD be the smaller axis and e be the half of it, area equals $d \times e \times \pi$.

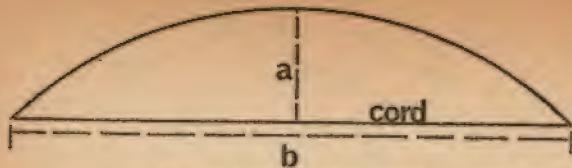
An approximate formula for the Circumference of an ellipse is

$$C = \pi \left(\frac{\sqrt{d^2 + e^2}}{2} + \frac{d + e}{2} \right).$$



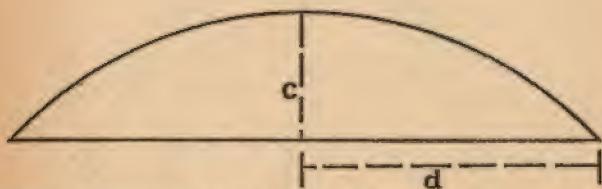
Area of Regular Polygon

Divide the polygon into triangles; find the area of one triangle and multiply by the number of triangles contained in the polygon.



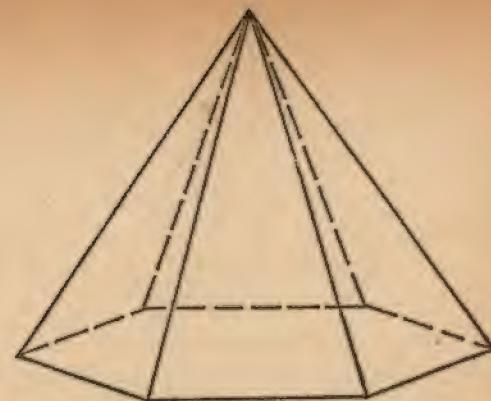
Area of Segment of a Circle

If a equals height of segment and b equals length of cord, area equals

$$\frac{a \times 2 \times b}{3} \times \frac{a^2}{2 \times b}.$$


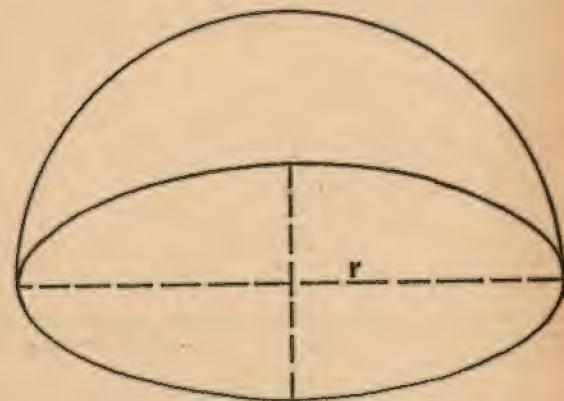
To find the diameter of the Circle to which any Segment may belong. Square half the cord, then divide it by the height of the segment; now add this to the height of the segment.

i.e. Diameter equals $\frac{d^2}{c} + c$.



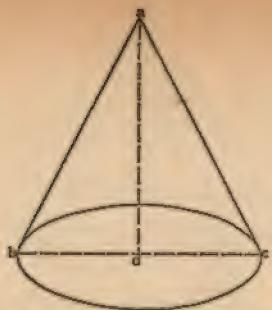
Area of Pyramid

Multiply the perimeter of the base by half the slant height, now add the area of the base.



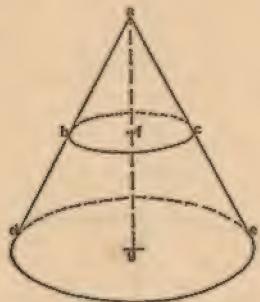
Area of Sphere

Area of a sphere equals four times the area of the diametrical section.
i.e. If r equals radius, area equals $4 \times r^2 \times \pi$.



Area of Surface of a Cone

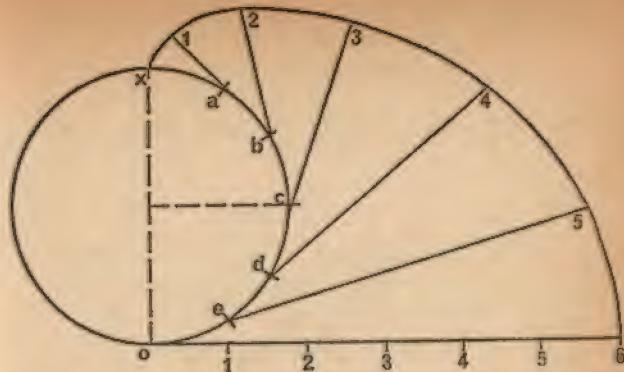
Area of surface of a cone equals the circumference of the base multiplied by one-half the slant height of the cone added to the area of the base, i.e. If ab is the slant height, bc the diameter and bd the radius of the base, area equals $\frac{bc \times \pi \times ab}{2} + (cd)^2 \times \pi$.



Area of the curved surface of the Frustum of a Cone

To determine the area of the above, multiply half the sum of the diameters of the two circular ends by π , now multiply this by the slant height of the frustum.

i.e. If b, c, d, e is the frustum, bc and de the two diameters, and bd the slant height, area equals $\frac{bc + de}{2} \times \pi \times bd$.



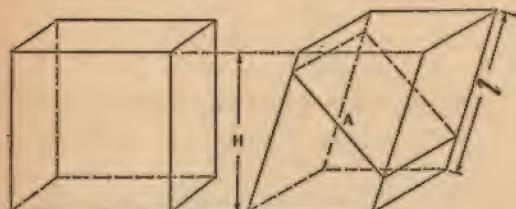
Involute Curve

If a point in a circle be unwound and extended in a straight line, the path of the point will form an involute curve.

To construct an involute - ocx is the circle and oe is a tangent equal in length to half the circumference of the circle. Now divide both the tangent and the semi-circle into any number of equal parts. From these points on the circle, a, b, c, d, e , draw tangents to the circle, $a1, b2, c3, d4, e5$, etc., equal in length to $o1, o2, o3, o4, o5$, etc., respectively. The curve is then described by joining the terminus of each tangent.

SURFACES AND VOLUMES OF SOLIDS

S = Lateral or Convex Surface. V = Volume

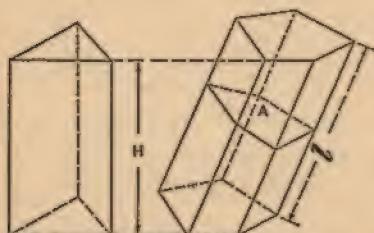


Parallelopiped

$S = Pl$. P is perimeter perpendicular to sides: l is lateral length.

$V = BH$. B is area of base; H is perpendicular height.

$V = Al$. A is area of section perpendicular to sides: l is lateral length.

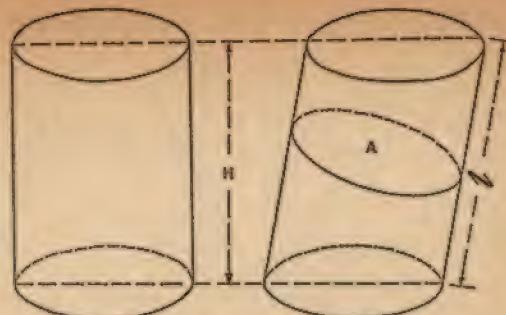


Prism, Right or Oblique, Regular or Irregular

$S = Pl$. P is perimeter perpendicular to sides: l is lateral length.

$V = BH$. B is area of base; H is perpendicular height.

$V = Al$. A is area of section perpendicular to sides: l is lateral length.



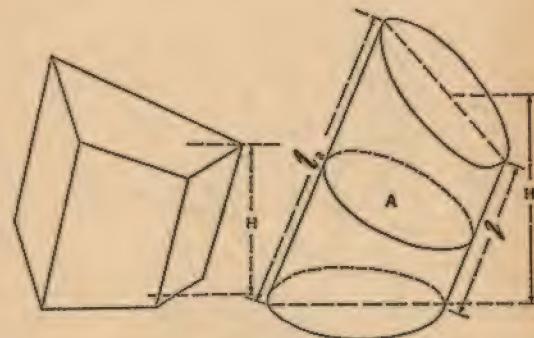
Cylinder, Right or Oblique, Circular or Elliptic, etc.

$S = PH$. P is perimeter of base: H is perpendicular height.

$S = P_1 l$. P_1 is perimeter perpendicular to sides: l is lateral length.

$V = BH$. B is area of base: H is perpendicular height.

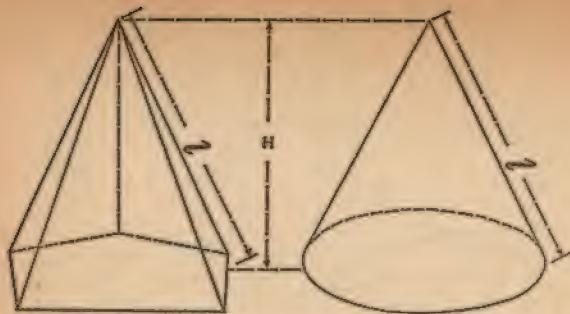
$V = Al$. A is area of section perpendicular to sides: l is lateral length.



Frustum of any Prism or Cylinder

$V = BH$. B is area of base: H is perpendicular height from base to centre of gravity of top.

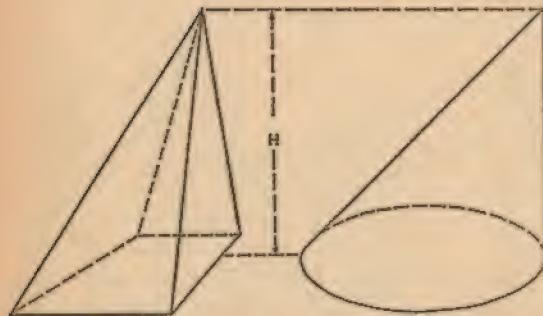
$V = \frac{1}{2}A(l_1 + l_2)$, for cylinder.



Pyramid or Cone, Right and Regular

$S = \frac{1}{2}Pl$. P is perimeter of base: l is slant height.

$V = \frac{1}{3}BH$. B is area of base: H is perpendicular height.

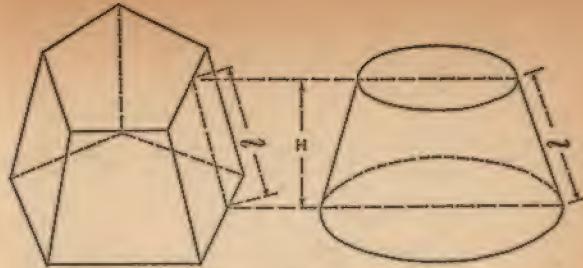


Pyramid or Cone, Right or Oblique, Regular or Irregular

$V = \frac{1}{3}BH$. B is area of base: H is perpendicular height.

$V = \frac{1}{3}$ volume of prism or cylinder of same base and perpendicular height.

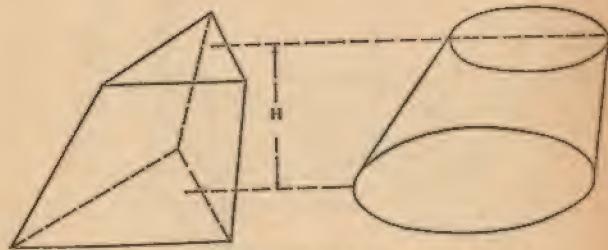
$V = \frac{1}{2}$ volume of hemisphere of same base and perpendicular height.



Frustum of Pyramid or Cone, Right and Regular, Parallel Ends

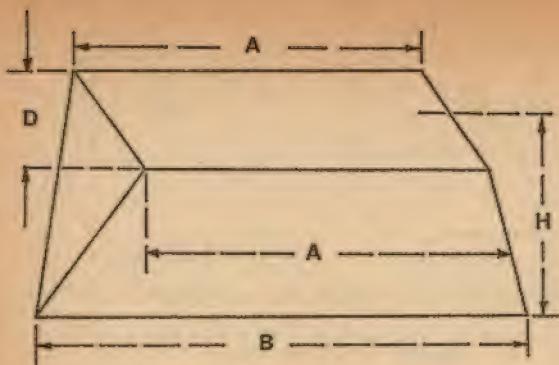
$S = \frac{1}{2}(P + p)$ P and p are perimeters of base and top: l is slant height.

$V = \frac{1}{3}H(B + b + \sqrt{Bb})$. B and b are areas of base and top: H is perpendicular height.



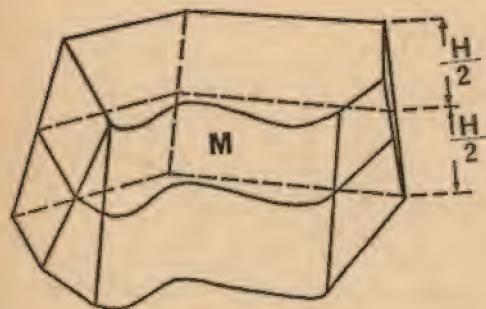
Frustum of any Pyramid or Cone, Parallel Ends

$V = \frac{1}{3}H(B + b + \sqrt{Bb})$. B and b are areas of base and top: H is perpendicular height.



Wedge, Parallelogram Face

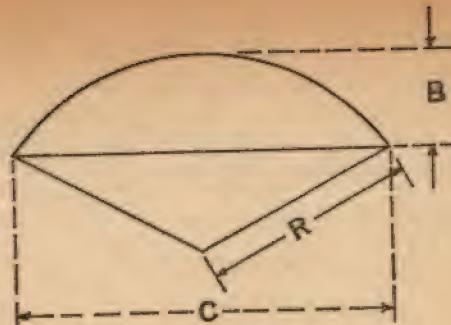
$V = \frac{1}{3}DH(2A + B)$. A, B, A are the lengths of the three edges: H is perpendicular height; D is perpendicular width.



Prismatoid

$V = \frac{1}{3}H(B + b + 4M)$. B and b are areas of base and top: H is perpendicular height: M is area of section parallel to bases, midway between them.

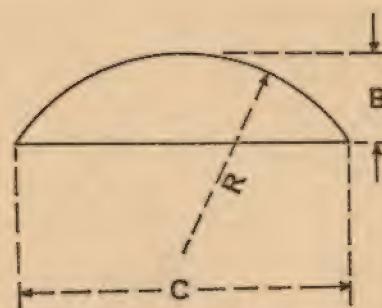
The Prismatoid formula applies also to any of the foregoing solids with parallel bases, to pyramids, cones, spherical sections, and to many solids with irregular surfaces.



Spherical Sector

$$S = \frac{1}{2}\pi R(4B + C)$$

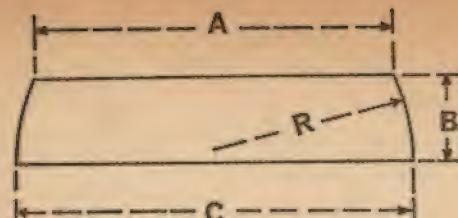
$$V = \frac{2}{3}\pi R^2 B$$



Spherical Segment

$$S = 2\pi RB = \frac{1}{2}\pi(4B^2 + C^2)$$

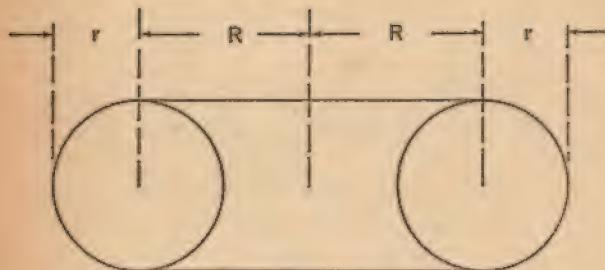
$$V = \frac{1}{3}\pi B^2(3R - B) = \frac{1}{3}\pi B(3C^2 + 4B^2)$$



Spherical Zone

$$S = 2\pi RB$$

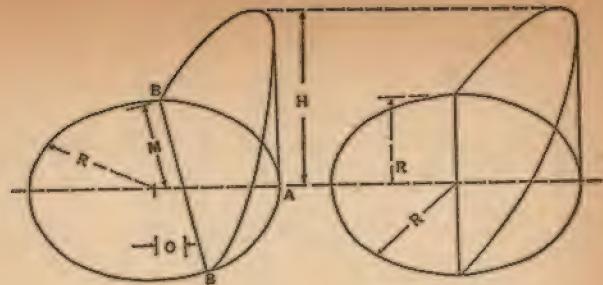
$$V = \frac{1}{3}\pi B(3A^2 + 3C^2 + 4B^2)$$



Circular Ring

$$S = 4\pi^2 Rr$$

$$V = 2\pi^2 Rr^2$$



Ungula of Right, Regular Cylinder

Base = Segment BAB

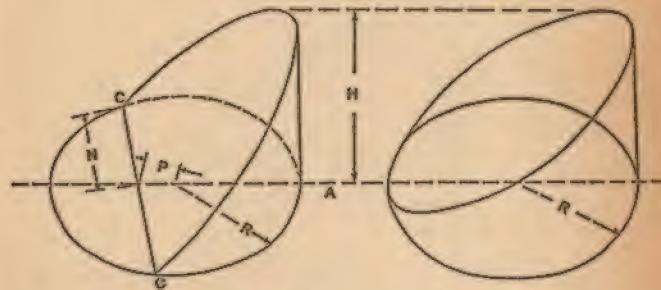
$$S = (2RM - O \times \text{arc, BAB}) \frac{H}{R-O}$$

$$V = (\frac{1}{3}M^3 - O \times \text{area, BAB}) \frac{H}{R-O}$$

Base = Half Circle

$$S = 2RH$$

$$V = \frac{1}{2}R^2H$$



Base = Segment, CAC

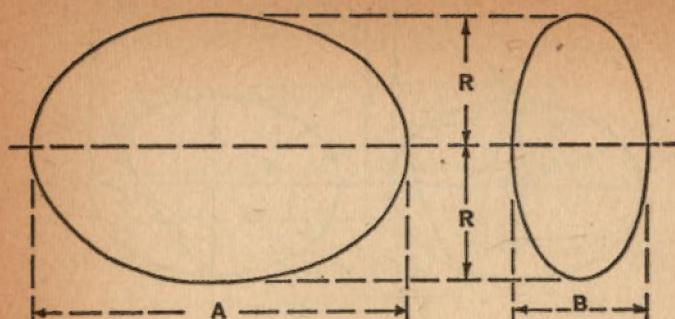
$$S = (2RN + P \times \text{arc, CAC}) \frac{H}{R+P}$$

$$V = (\frac{1}{3}N^3 + P \times \text{area, CAC}) \frac{H}{R+P}$$

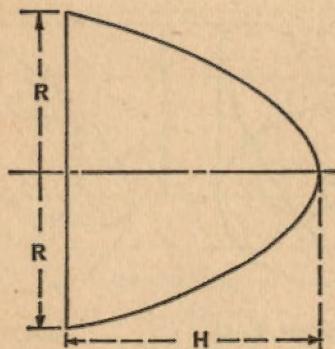
Base = Circle

$$S = \pi RH$$

$$V = \frac{1}{2}\pi R^2H$$



Ellipsoid
 $V = \frac{1}{3}\pi RAB$



Paraboloid

$$V = \frac{1}{3}\pi R^2 H$$

Ratio of corresponding volumes of a Cone, Paraboloid, Sphere, and Cylinder of equal height = $\frac{1}{3} : \frac{1}{2} : \frac{4}{3} : 1$.

NOTES



TO FIND ANGLE OF A WEDGE

$$\frac{2\pi l A}{B}$$

NOTES

NOTES

NOTES

compiled by
A. MONTAGUE-BEART

TP84

MATHEMATICAL TABLES

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